UPPER AND LOWER SIMMONS RESERVOIRS DREDGING STUDY PREPARED FOR

RHODE ISLAND SOLID WASTE MANAGEMENT CORPORATION BY MAGUIRE GROUP INC.

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RHODE ISLAND SOLID WASTE MANAGEMENT CORPORATION

SIMMONS UPPER AND LOWER RESERVOIRS

DREDGING STUDY

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EXECUTIVE SUMMARY

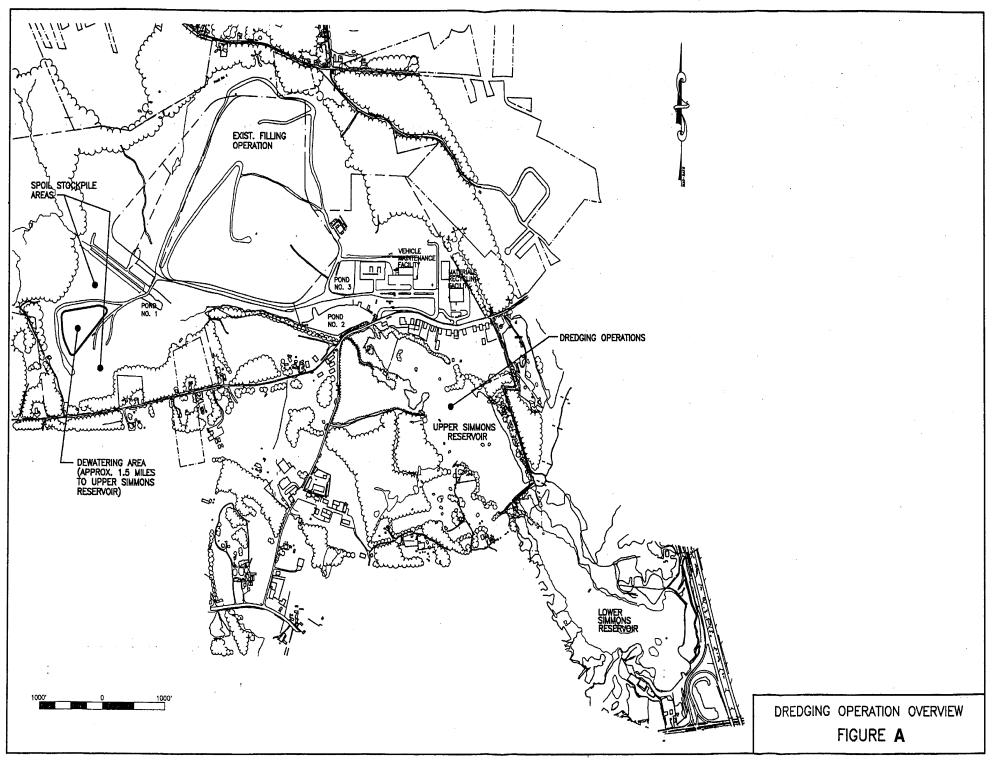
RISWMC was ordered by DEM to take corrective actions to restore specific wetlands altered by the landfill operation. The Upper Simmons Reservoir requires approximately 250,000 cubic yards of sediment removal. No observable sediment deposits were found in the Lower Simmons Reservoir and removal is not proposed.

The first phase of the plan is to remove deposited sediment from the Upper Simmons Reservoir. This report investigates the classification and amount of sediment, as well as various methods of removal. Hydraulic and mechanical methods are described along with locations of dewatering areas.

Hydraulic dredging was found to be the most efficient method of removing the type of sediment found. Dredging will be performed in a general north to south manner. As shown on Figure A, the dredged material will be pumped approximately 1.5 miles to a dewatering and spoils area located on the southwest corner of the landfill property. When dried, the dredge spoil will be used as cover material for the landfill.

The approximate time required to complete the entire dredging operation is 14 months and will cost approximately \$2.9 million.

Under the Consent Agreement, prior approval from DEM is not required prior to commencing dredging. A Water Quality Certificate will be required from DEM, Division of Water Resources. Prior U.S. Army Corps of Engineers approval has expired. The Corps of Engineers has been contacted to ascertain if a further extension may be granted or if an application for a permit must be filed. As of the writing of this report, the Corps of Engineers had not made a final determination.



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I. INTRODUCTION

A. AUTHORIZATION

This study has been developed for Rhode Island Solid Waste Management Corporation (RISWMC) to address portions of the work required in the Rhode Island Department of Environmental Management (DEM), Revised and Amended Consent Agreement, dated July 24, 1991. The focus of the study is the required work described in Part III of the Agreement which pertains to the removal of accumulated inorganic sediment deposited within Cedar Swamp Brook and Upper Simmons Reservoir and the determination of the location and extent, if any, of inorganic sediments in Lower Simmons Reservoir.

B. BACKGROUND

RISWMC was notified by DEM of an alleged violation of the Rhode Island Freshwater Wetlands Act (R.I.G.L., Section 2-1-21) in March of 1985. The Notice of Violation stated that RISWMC had caused wetlands on and adjacent to the site of the RI Central Landfill to be altered without the permission of the Director of DEM as required by the Freshwater Wetlands Act. RISWMC was ordered to take certain corrective actions and to pay an administrative fine. RISWMC agreed to resolve the violation in a Consent Agreement executed in November of 1986. In April of 1989, DEM issued a Notice of Intent to Enforce the Freshwater Wetlands Act and required RISWMC to take specific actions to stop alterations and submit

necessary reports and studies relating to the restoration of wetlands. RISWMC agreed to take the necessary actions in an amended Consent Agreement in July of 1989. Subsequent to that time, DEM required an amended Consent Agreement as a condition of approval for a permit for landfill expansion. This plan responds to the requirements of the revised and amended Consent Agreement which pertain to the removal of sediments in those bodies of water and surrounding wetlands listed above.

The operation of the landfill requires continuous and extensive soil disturbance for landfilling, grading, excavation and placement of cover material, disposal of unsuitable soils (especially boulders), stockpiling, composting, and construction of landfill related facilities. Major portions of the site (over 300 acres) are presently open for excavation related to landfill operations and the expansion of landfill capacity. The substantial amounts of fine sediments deposited in site drainage structures indicate that the soils on the site are silty and clayey. This type of soil is very vulnerable to erosion. Worse, once these types of soils are eroded they are easily transported and settle out of suspension very slowly.

The construction of erosion control structures and other measures taken since the RISWMC and DEM entered into the initial Consent Agreement appear to have had some impact on the amount of material reaching the downstream areas. It is clear, however, that despite the efforts of RISWMC, erosion and sedimentation problems persist at the landfill site. The continued transport of fine-grained silt and clay-sized particles from the site to downstream wetlands, water courses and water bodies has

resulted in the degradation of water quality and the determination by DEM that there is an ongoing violation of the Freshwater Wetlands Act.

This report is the first phase of a plan to remove the accumulated sediment from the affected areas and to restore those areas to a state approximating their condition prior to the disposition of the materials.

The effective removal of those materials by dredging or excavation and its subsequent handling, treatment and transport are the issues discussed herein. Beyond the scope of this report are the measures required to curb further sedimentation and to resolve other outstanding sedimentation and erosion control issues. Primary among the outstanding issues is the drainage channel or "chute" on the southeast face of the existing landfill. This chute is a continuing, major source of sediment.

II. SEDIMENT SOURCES

A. CENTRAL LANDFILL

As noted above, ongoing landfill operations on the site require extensive earth moving activities. These areas constitute the primary sources of sediments entering the Upper Simmons Reservoir.

Maguire Group prepared "Working Operational Erosion and Sedimentation Control Plan," October 22, 1991, for RISWMC. This plan identified seven focal areas on the landfill site which are characterized by disturbed, erodible, non-vegetated and non-stable soils. The following information is summarized from the plan and is listed in order from those sources considered to be the most significant to those considered to be the least significant sources of sediment:

- The "chute" down the southeast face of the landfill which is an unstabilized waterway subject to large volume, high velocity flow.
- The excavation area in the southwestern corner of the landfill property where cover material is being extracted and various earth and rock materials are stockpiled.
- The west face of the landfill, a steep, unstabilized slope with a very large surface area subject to erosion.

- The quarry, an open area west of the landfill within which a stream flows along a poorly defined channel which meanders over unstabilized soils.
- The eastern faces of the landfill, steeply sloping areas of unstabilized soil subject to severe hill and occasional gully erosion.
- The boulder disposal area east of the landfill where boulders extracted during cover material excavation are stockpiled and buried.

In addition to the sources of sediment listed above, a "Planned Activity Areas" category of potential sediment sources has been identified. This category consists of areas where planned activities will result in soil disturbance (see "Rhode Island Central Landfill Working Operational Erosion and Sedimentation Control Plan," dated October 22, 1991). These include:

- The "Bowl" Area of the Landfill where solid waste will continue to be placed,
 compacted and covered over,
- The Top and Southeast Faces of the Landfill where solid waste will be placed,
 compacted and covered over to bring the surface to final elevation and then
 closure will be accomplished,
- The Expansion Area where construction of the leachate collection system, the base liner subgrade and the interface liner will be accomplished,

- The Excavation Area in the southwest corner of the site where cover material removal activities will continue,
- The Quarry Stream Channel where earthwork and blasting will relocate existing stream flow westward, outside the landfill expansion area,
- Stockpile and Compost Areas where cover material, fill for construction of the landfill expansion, and loam will continue to be stockpiled and compost operations will continue to be stored temporarily,
- The Boulder Disposal Area where boulders will continue to be stockpiled,
 blasted, and buried,
- The Resource Recovery Facility Site where construction of a new waste to energy facility is planned,
- A Possible New Landfill Location where a new landfill may be constructed on, or adjacent to, RISWMC property.

B. OTHER SEDIMENT SOURCES

The present turbidity levels and amount of deposited sediments in the Upper Simmons Reservoir is at extreme values. It is evident that the Upper Simmons Reservoir contains approximately 250,000 cubic yards of sediment deposits. The

majority of this sediment comes directly from the landfill; however, neighboring open gravel pits and local industry also contribute to the present turbidity levels. Stormwater from these neighboring sites enters the reservoirs directly and by means of tributary streams. These areas include:

- Open borrow pit west of Upper Simmons Reservoir.
- Light industrial area northeast of Upper Simmons Reservoir, perimeter areas
 of exposed soil and borrow/stockpile areas.
- Active borrow pit east of Simmons Lake Drive.
- Light industrial area west of Upper Simmons Reservoir at the intersection of Shun Pike and Green Hill Road.
- Open borrow pit and composting area west of Green Hill Road.
- Open borrow pit between Green Hill Road and Upper Simmons Reservoir.
- Unstabilized soils over recently installed gas line. This poses a direct potential threat to Lower Simmons Reservoir.
- Road reconstruction and various building construction along Plainfield Pike.

As sediment sources on the landfill property are reduced and eliminated, these off-site sources will become more significant.

III. FIELD INVESTIGATIONS

A. SEDIMENT SAMPLING PROGRAM

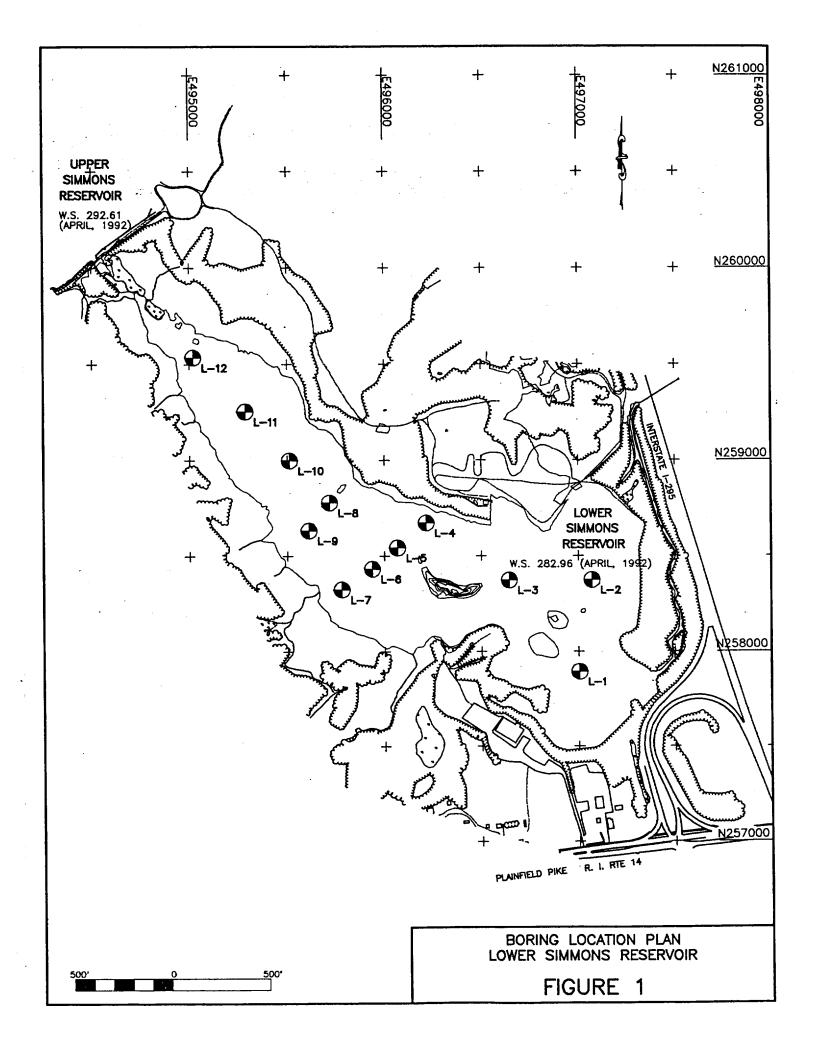
A sampling program was undertaken to determine the extent of reservoir sedimentation as a result of landfill cover erosion. The program's results assist in determining the extent and method of sediment removal that will be required. The program consisted of 22 borings located within the Upper Simmons and Lower Simmons Reservoirs executed during the period Monday, April 27 through Thursday, April 30, 1992. Ten borings were located in the Upper Simmons Reservoir, designated Ul through U10, and twelve borings were located in the Lower Simmons Reservoir, designated Ll through L12, see the attached boring location plans (Figures 1 and 2) and boring logs, Appendix A.

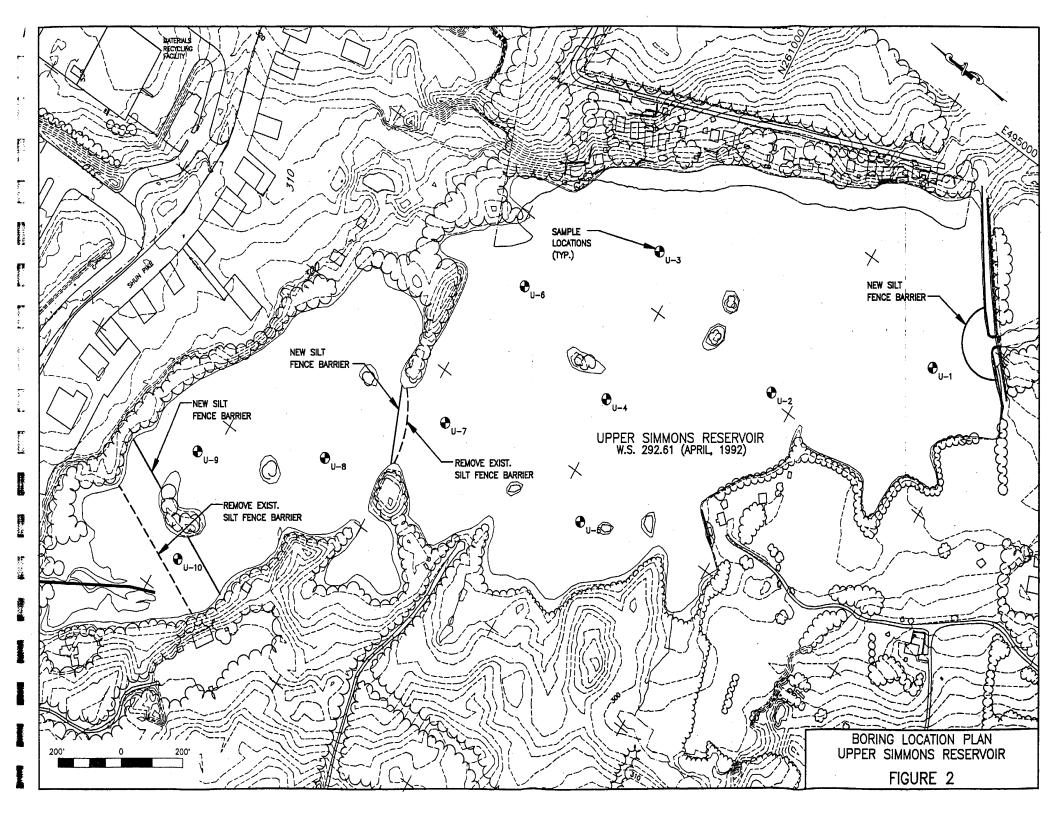
Sediment samples were obtained by Guild Drilling under the direction of an MGI engineer. An 18-foot flat bottomed steel work boat was utilized for the boring program. An "As-Sampled" location was recorded for each boring. Survey control was provided by Weiler Mapping, Inc. by landbased survey methods.

The elevation of the water surface in each reservoir was obtained by Weiler. The water surface elevations were:

Upper Simmons Reservoir 292.61

Lower Simmons Reservoir 282.96





B. SAMPLING METHODOLOGY

The typical sampling procedure was as follows:

- Anchor the boat at the approximate boring location,
- Lower and secure a 3-inch diameter casing to the sediment surface for multiple samplings in the same hole, as required,
- Press a 24-inch long split spoon sampler into the sediment utilizing the weight of rods and drillers,
- Depending upon the thickness of the soft sediment, either retrieve the sampler and press a second time until firm bottom was reached or in one motion press the sampler until firm bottom was reached.

The boring program was initiated at the southern end of Upper Simmons Reservoir. In the initial borings, the reservoir "firm bottom" material was sampled by driving the split spoon with a 140-lb. hammer. This method provided a sufficient sample to characterize the "original" reservoir bottom material. The remaining borings terminated at the firm bottom interface, recovering only an inch or two of the original bottom material. The difference between recent inorganic sediment and original organic material was readily distinguishable by color, texture and consistency.

The sediment samples were photographed for record purposes and to document the interface between the landfill derived silt and the underlying peat.

C. FINDINGS

In the Upper Simmons Reservoir, from the sediment surface to firm bottom typically three strata were observed. From top to bottom the observed strata were:

- Gray loose Silt (landfill sediment),
- Brown/black soft fibrous Peat, and
- Light gray, medium-dense Silty fine to medium <u>Sand</u>, trace fine gravel.

These three strata were distinctly quantified (on the boring logs) by their respective resistance to the sampler penetration. The recovered sample lengths generally were not indicative of the actual stratum thickness due to their extremely loose consistency, although representative material from each layer present was recovered from all sampling locations.

It is noteworthy that the surficial sediment (landfill sediment) was only observed in the Upper Reservoir. There was no landfill sediment observed at any of the borings in Lower Reservoir. The Lower Reservoir contained soft peat overlying firm bottom material in all borings. Boring L-8 contained no peat at all.

The Upper Reservoir contained much suspended silt/clay-size particles in the water as indicated by a distinct brownish color and a visibility of only several inches. By contrast the Lower Reservoir, although not clear, had a much improved visibility and only a trace of the brownish water color at the northern end. At most sample locations (water depths of about 1 to 4 feet), the bottom of the pond could be seen through the water of the Lower Reservoir.

The following is a summary of the boring information obtained from both

Reservoirs. Enclosed figures 1 and 2 indicate boring locations in the Upper and

Lower Reservoirs, respectively. Logs for the borings are included in Appendix A.

<u>UPPER SIMMONS RESERVOIR</u> Water Surface Elevation 292.61

Boring		Depth in Feet		
No.	Water	Sed.	<u>Peat</u>	Location
U 1	9.0	0.5	4.8	Southern End of
U 2	9.0	3.0	1.2	Upper Reservoir
U 3	7.0	4.0	13.5	
U 4	8.0	3.0	2.0	
U 5	5.0	2.0	0.5	
U 6	5.0	1.0	0.0	
U 7	7.0	4.0	1.8	
U 8	5.5	3.5	0.5	
U 9	4.5	2.0	0.2	
U10	1.7	3.0	1.0	Northern End of
				Upper Reservoir

LOWER SIMMONS RESERVOIR Water Surface Elevation 282.96

Boring	Depth in Feet			
No.	Water	Sed.	<u>Peat</u>	Location
L 1	2.0	0.0	1.8	Southern End of
L 2	3.7	0.0	1.8	Lower Reservoir
L 3	2.5	0.0	1.7	
L 4	1.5	0.0	1.3	
L 5	2.8	0.0	2.8	
L 6	2.0	0.0	1.8	
L 7	1.3	0.0	3.8	•
L 8	1.0	0.0	0.0	
L 9	1.0	0.0	2.8	
L 10	1.0	0.0	3.3	
L 11	1.5	0.0	3.3	
L 12	0.8	0.0	3.8	Northern End of
				Lower Reservoir

The results of the program confirms the entire Upper Reservoir contains levels of deposited sediment ranging from 0.5 feet at the southern end to in excess of 5 feet in the north. The extent of organic deposits beneath the sediment layer were found to be deeper than expected with an average depth of 2.5 feet. The original organic bottom material was found to be both deeper and softer than expected. Total quantity of sediment deposits determined by the depth of sediment for the entire reservoir = 2.5 feet + 6", overdredge = 3 feet. 3 feet x 51 acres x 43,560 ft./acre ÷ 27 = 246,840 cubic yards.

The Lower Reservoir was found to have no observable layer of recent inorganic sediment above the original reservoir bottom. No action needs to be taken to remove sediment from the Lower Simmons Reservoir.

Prior sampling studies were taken in the Upper Simmons Reservoir. A chemical analysis of these samples was conducted and the results, located in Appendix C, indicate the amounts of contaminants contained in the samples.

IV. DREDGING METHODS

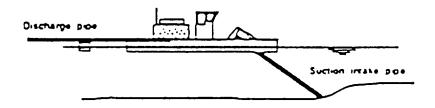
A. OPTIONS

Removal of the accumulated inorganic sediments from the affected water body could be accomplished in a number of ways, with the most effective program possibly resulting in the use of different methods and technologies in different areas. The basic task, whether completed in submerged or exposed land, is one of excavation. Traditional earthmoving equipment (backhoes, shovels, crane-mounted clamshells) can be effectively utilized in areas where the sediments to be removed are of substantial thickness and firm composition. Earthmoving equipment has the advantage of the removal of a high concentration of solids and little water. This method would be feasible where the material to be excavated is primarily sand and gravel, or where it is sufficiently dense to be removed in a cohesive mass. The only portion of the project area where this may be the case is at the delta formed at the northern extreme of the Upper Simmons Reservoir, and the portion of Cedar Swamp Brook between the Reservoir and Shun Pike. In the remaining Upper Reservoir, where the sediment layer is thinner and consists primarily of soft silt and clay-size particles, a small floating hydraulic dredge may work most efficiently.

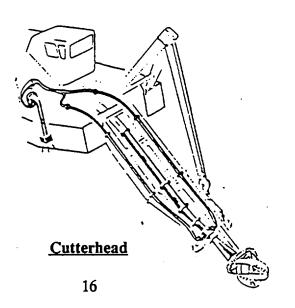
1. Hydraulic Dredging Methods

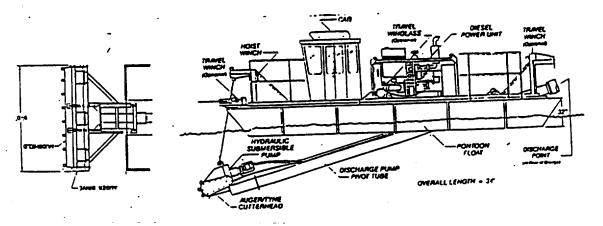
Hydraulic dredges employ centrifugal pumps to create suction in a pipeline which lifts sediments from the waterway bottom. Typically, mechanical means are employed at the head of the pipeline to disturb or loosen bottom sediments which are then pumped in the form of a slurry. The content of the slurry may be as much as 80 to 90% water and only 10 to 20% sediment. Dredging techniques and the various types of equipment available are discussed in more detail and are shown in sketches below.

Three general hydraulic dredging methods are plain suction, cutterhead and horizontal auger, as shown below.



Plain Suction





Horizontal Auger

The plain suction hydraulic dredge uses the suction developed by a centrifugal pump to lift the slurry of water and material through a pipeline from the bottom, relying solely on the velocity of the incoming water to loosen and remove bottom material. The suction line is supported by a boom or "ladder" which is raised, lowered and laterally controlled from the floating dredge. The suction line typically has, at its intake end, a screened bell—shaped nozzle to protect the pump and increase efficiency. This type of hydraulic dredge is designed to dredge loose sands and silts and is not suitable for compacted materials.

The cutterhead hydraulic dredge employs essentially the same suction system, except that an electrically or hydraulically driven rotating cutterhead is located at the intake end of the suction line. The cutterhead "chews up" the material, thus enabling the dredge to excavate harder materials than the basic suction type. Variations in the design of the cutterhead allow the dredge to excavate most types of material efficiently. Because the most versatile of the hydraulic dredges is this cutterhead type, it is the type owned by many

dredging contractors having large hydraulic dredges. Small road-transportable dredges may also be equipped with cutterheads.

Horizontal auger dredges are used on small, road-transportable dredges. The horizontal auger dredge generally has a wide flat "dustpan" shaped intake structure with a laterally mounted rotating cutter which dislodges material and feeds it to the suction line at the center. The auger is lowered to a specified depth and cuts a swath as the dredge is moved forward.

Hydraulic dredges are typically categorized in size by suction line diameters which range from 6 to 32 inches. For this project, a line diameter of 8 inches is anticipated. Typically, material dredged hydraulically is transported via a pipeline to either a nearby barge for disposal, or to a nearby landside containment area for dewatering. Dewatering and disposal methods are discussed later in this report.

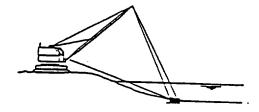
Production rates for hydraulic dredging are highly variable and are a function of the type and consistency of material being excavated, depth of dredging, disposal method, pumping distance and dredge characteristics, such as suction line diameter and pump horsepower. Production rates are also dictated by the size of the containment area for dewatering or other disposal limitations.

Hydraulic dredges generate little turbidity in the water at the dredge location as the dredging action tends to pull this water into the suction line. However, they do generate large volumes of silt-laden water which must be cleaned at the dewatering area before being returned to a natural water body.

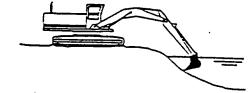
2. Mechanical Dredging Methods

Mechanical dredging is simply the use of standard earth excavation equipment for the removal of submerged soil. If the area to be dredged is within reach of shore, little adaptation in equipment is required. Two types of equipment generally employed for shoreline mechanical dredging operations are the backhoe and dragline, as shown below. The backhoe may be modified with an extended arm to reach further out from the shoreline to remove soil.

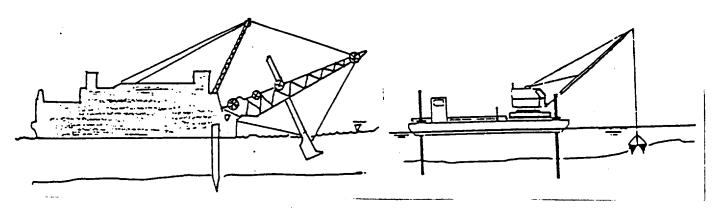
The dragline is an open shovel or scoop suspended from a crane boom. The shovel is lowered to the bottom and dragged toward the crane, filling with scraped material as it travels.



Dragline crane working from shore



Tracked backhoe working side slope



<u>Dipper</u> <u>Clamshell</u>

For mechanical dredging of areas away from shore, both the backhoe and dragline could be utilized as well as a dipper and clamshell dredges. Any of these methods would require barge mounting so as to be easily moved about on the water body. A dipper dredge is similar to the backhoe, but excavates on an outward lifting motion rather than back towards the operator as a backhoe does. This dredge is effective in removing cemented sediments and other firm materials such as glacial till, boulders, and blasted rock. The depth of dredging is limited by the length of the shovel arms. A clamshell is an open bucket mounted to a crane or a barge and lowered vertically to the soil. It is a proven and effective means of removing a large range of sediment types.

The dredged material from mechanical dredging may be deposited directly to a truck on shore or onto an adjacent barge. This barge is transported back and forth between the dredge area and a rehandling area on shore.

Mechanical dredging is common for dense soils, large quantities, thick layers, deep water, and for pier-side dredging. It is also used when site constraints

severely limit the area available for dewatering, as the solids-to-water ratio for mechanical dredges is much higher than for hydraulic dredging, therefore eliminating or reducing the dewatering area.

Unlike hydraulic dredging, mechanical dredging may produce significant amounts of turbidity of the dredge location. This turbidity is difficult to contain or control.

3. Draining Upper Simmons Reservoir

Consideration was given to removal of sediment from Upper Simmons Reservoir in the dry utilizing standard earthmoving equipment. This would require draining of the reservoir. Historically, the two reservoirs have been periodically drained to accommodate the needs of the mills downstream, using them as a source of process water. Unfortunately, the organic sediments underlying the soils to be dredged are too soft and thick to support earthmoving equipment. Therefore, this option of sediment removal is not a practical alternative.

The preferred routing of a dredge pipeline from Upper Simmons Reservoir would be along Cedar Swamp Brook. The adjoining property is not owned by RISWMC, and thus far the owners have not agreed to allow easements. As an alternate, a much longer and more costly routing could be through RISWMC owned property on the east side of the reservoir. The pipeline

would go north along the west shoulder of Simmons Lake Drive. The pipe would require burial to cross Shun Pike before heading west toward RISWMC property. If the easement is granted, the pipeline and dredging of the brook would result in some disturbance of wetlands in that area.

The delta which has formed in the Upper Simmons Reservoir at the mouth of Cedar Swamp Brook contains a thick deposit of sand and gravel, as well as fine-grained soils. Portions of this delta are accessible from shore. Because of this, large amounts of the delta could be effectively removed with a backhoe or dragline from shore. A dragline would be capable of reaching out 60 to 70 feet. This material excavated would require little or no dewatering and could be deposited directly into dump trucks and hauled to the landfill for cover material. However, the shoreline of Upper Simmons Reservoir adjacent to the delta is not owned by RISWMC, making this method of dredging impractical.

B. PROPOSED DREDGING METHODOLOGY

A horizontal-auger dredge would probably prove to be the most efficient means, since most of the dredging will involve the removal of a relatively thin layer of sediment from the existing bottom. Some specifics of the dredge which should be employed are:

- 1. Approximate rated dredge pump capacity of 2,000 gallons per minute.
- 2. Draft no more than 21 inches.

- 3. Approximate suction pipe diameter 8 inches.
- 4. Approximate discharge pipe diameter 8 inches.

A hydraulic dredge of this type would be road-transportable and could be launched by crane from RISWMC owned property on the east shore of Upper Simmons Reservoir, resulting in minimal disruption to surrounding wetlands. The configuration of the majority of Upper Simmons Reservoir, combined with the depth and type of sediment, do not lend themselves to efficient dredging by mechanical means. A road-transportable, horizontal-auger hydraulic dredge is judged to be the appropriate choice. These dredges are available in a variety of sizes that can be transported on a trailer and offloaded with a crane. Many dredges can work in less than 2 feet of water with the capability of dredging to a depth of 15 feet. Both are reasonable limits for this project. The 8-inch discharge pipeline from the dredge to the spoil area would be floated on the reservoir to Cedar Swamp Brook. From there, it would run along the brook, through the culvert at Shun Pike, and then over land to the dewatering area. The length of pipeline from the southernmost point on the Upper Simmons to the dewatering area will be about 1 1/2 miles and the difference in elevation from dredge to discharge will be about 80 feet. This will necessitate the use of at least one booster pump somewhere along the pipeline to maintain adequate flow velocity. The location and number of booster pumps will be dependent upon the actual equipment selected by the Contractor.

As stated earlier, in addition to the equipment utilized, the dredge rate is controlled by the size of the containment area and/or the dewatering process. A horizontal auger dredge with an 8-inch discharge line is estimated to be capable of removing 180 cubic yards of sediment per hour. This quantity is higher than that of the same dredger in gravelly or sandy conditions due to the soft silty sediments encountered. Usually, the dredgers operate at a 4 to 1 water to soil ratio. However, with the soft sediments being dredged, it may be possible to achieve a 1.5 to 1 ratio. This will make the operation more efficient and reduce the dewatering process.

C. FIELD CONTROL

Control of the dredging operation will require setting several points around the perimeter of the reservoir for vertical and horizontal control. The location of the dredge can be determined by optical and/or electronic survey equipment at control points on-shore.

Because of the high turbidity in the Upper Simmons Reservoir and the condition of the extremely soft sediment, manual inspection or accurate soundings of the bottom cannot be made. Therefore, dredge depths have been estimated based on the sediment data collected. To set actual dredging depths, it will be required that the dredging contractor perform numerous probes and take samples as the dredging progresses. In this manner, limits can be determined at the time of dredging.

D. TOLERANCES

Dredging tolerances vary with the type of dredge and the quantity being removed. Dredging is typically conducted to a uniform elevation over a given area. A hydraulic dredge would be set to a predetermined depth and would remove all material to that elevation. To accomplish the removal of inorganic sediments from Upper Simmons Reservoir, the dredge must be adjusted to dredge to the depth of the top of the organic layer. From a practical standpoint, there are no commercially available dredges that are able to follow bottom contours and remove varying thicknesses of material. The minimum depth of material able to be removed by available equipment about 6 inches, with a practical minimum tolerance of ±6 inches. If the bottom elevation varies significantly in a small area, the dredge must be set at the lowest elevation. The resulting thickness of organic material removed will also vary accordingly.

The tolerance set forth by the DEM consent agreement requires the removal of any sediments with 1-inch depth or greater. As all sample locations in the Upper Reservoir encountered at least 1/2 foot of sediment, the minimum thickness to be removed appears to be compatible with the anticipated equipment. However, there will be a significant problem associated with controlling the amount of natural, organic sediments that will be removed to assure complete removal of the landfill sediments.

The consent agreement states that:

"Dredging shall be to the original organic material beneath the deposited inorganic material and substantial efforts will be made not to exceed a depth more than six (6) inches below the inorganic/organic interface encountered during dredging operations."

This restriction will be difficult to comply with for several reasons. First, the vertical accuracy of the dredging equipment is about the same as the stipulated limit. Therefore, to assure complete removal of the inorganic sediment, with an equipment accuracy of ±6 inches, it can be expected that at a minimum zero to 12 inches of organic material will be removed with the average amount removed being at least 6 inches.

Several steps will be taken to limit the extent of overdredging. The top surface of the inorganic sediment will be determined by physical and/or acoustic soundings. The top of the underlying organic layer will then be determined by physical probings. Samples will also be taken periodically to verify the methodology. Based upon the results of the probings, a dredge depth will be established for the surrounding area. The extent of area to be dredged to a set elevation will depend upon the variability of the surface of the underlying organic layer.

Verification of the removal of inorganic sediment will be done by taking additional, post-dredge soundings and samples.

V. DEWATERING AND DISPOSAL METHODS

A. MECHANICAL SYSTEMS

There are several mechanical package systems available which, through a series of physical and chemical means, will dewater and consolidate solids from a slurry and produce a clear filtrate and a spoil material which is sufficiently dry to handle, truck and spread. The configuration of the systems are dependent upon the area available and materials being handled. Typically, these systems are made up of a combination of hydrocyclones, centrifuges, belt presses, or filter presses. Chemical additives such as flocculants may be added at some time during the process to accelerate the separation of solids and water.

Sand and coarse-grain materials can be separated out in the hydrocyclones or centrifuges. For finer materials, filter presses or belt presses are required. Filter presses utilize high operating pressures and filtering media to separate liquid from the slurry, producing a filter cake and a clear filtrate. The filter cake is typically dry enough to be transported in open trucks and be used on the landfill immediately.

The advantages to a mechanical dewatering system are twofold. First, the process is much quicker than traditional dewatering and drying in a basin. Second, space requirements are minimal compared to that required for a dewatering basin. A system capable of processing 1,200 gallons of slurry per minute would take up an area roughly

40 feet by 100 feet. If greater production rates are required, multiple system installations can be provided.

The major drawback of this procedure is the cost. The price per cubic yard to mechanically dewater dredge spoil is about twice that of the cost of utilizing more conventional dewatering basins. As a result, these systems have historically only been used where space limitations prohibit conventional settling basins for dewatering. Since area is available for dewatering basins, it is anticipated that mechanical methods will not be used.

B. DEWATERING AREA

An area designated for the purpose of separating the water from the dredge spoils and sediments must be located upland of the Upper Simmons Reservoir. The average dredge discharge is anticipated to consist of approximately 80% water and 20% sediment. This requires a substantial area and volume to both contain spoil material and act as a sediment pond. To accomplish this, two dewatering basins will be excavated adjacent to each other. Each will be large enough to accommodate over 25,000 cubic yards of spoil and sediment to allow settlement of suspended sediments. Each basin flows into a secondary settling pond to increase settlement of suspended silt and clay sediment. Check dams and siltation barrier baffles will be provided to increase settlement and control outfall turbidity. The proximity of the two basins to each other will allow easy movement of the discharge pipe to enable alternate cleaning of the basins as they fill. Each basin will be allowed to fill three-quarters full with

sediment before the discharge pipe is moved. This should occur after approximately two weeks of efficient dredging. It will then be allowed to dry for approximately 4 days to allow mechanical equipment to remove the sediment and stockpile it in nearby areas for future use.

Dredge spoil material, once dewatered, is to be utilized as cover material for the landfill. Therefore, the location of the dewatering area becomes a function of its proximity to both the Upper Simmons Reservoir and the landfill.

Physical constraints affecting the dredge pumping operation are vertical rise above the dredge machine, distance to dewatering pond and available area. Several locations for the dewatering area were considered, including some not owned by RISWMC. These privately owned sites were remote from the filling operation, making hauling of spoil more costly. Additionally, RISWMC decided not to consider these outside areas due to the probable costs and difficulties associated with obtaining the necessary easements. Sites considered on RISWMC property did not offer the necessary acreage or were in conflict with proposed or on-going activities at the landfill.

The location chosen at the southwest corner of RISWMC property appears to be the most practicable for the dewatering area. There are over 14 acres available, sufficient for the dewatering operation. Access is provided by existing landfill haul roads. Pumping distance from the reservoir is approximately 1.5 miles, and the elevation rises 80 feet above the reservoir surface. The dredge piping can be laid along the side of existing roads and within existing drainage paths and culverts at road crossings

eliminating any impact on traffic or landfill operations. The location of the dewatering area on the southwest corner of the landfill makes it efficient for hauling dried dredge spoil to the landfill for covering operations.

C. FLOCCULANTS

Flocculants can be added to help reduce turbidity in the watering areas by settling out suspended particles which would normally stay in suspension. One such flocculant which has been used in this capacity is alum. Alum $A1_2(SO_4)_3$ (Aluminum Sulfate) can be added in a liquid form to the dewatering ponds.

The alum combines with the suspended solids, increasing their weight and causing them to settle. It is usually applied at a 1 to 10,000 ratio by a sprayer boat or by hand.

Application of 100 gallons of alum to the dewatering basin each night after the operation stops should decrease turbidity in the outfall water greatly. Approximately 20,000 gallons of alum would be required for the duration of the project.

VI. EASEMENTS

One easement will be required for cleaning of the brook for routing of the dredge spoil pipe along Cedar Swamp Brook, from Shun Pike to the Upper Simmons Reservoir. To accomplish this work, a 40° wide easement is required through Plat 31, Lot 006. The property is not owned by RISWMC, and thus far the owner has not agreed to provide an easement. As an alternate, a much longer and more costly routing could be used through RISWMC owned property on the east side of the reservoir, and then follow Simmons Lake Drive and cross Shun Pike to enter the landfill property at the southeast corner near the Materials Recycling Facility. Permission would be required from the Town of Johnston for this routing.

Equipment access to the Upper Simmons Reservoir can be via property owned by RISWMC on the southeast shoreline of the reservoir.

VII. SCHEDULE

The scheduling for the entire operation is dictated by the capacity of the dredge. A hydraulic horizontal auger dredge with a 2,000 gal/min. pump will enable removal of approximately 1,440 cubic yards of sediment per day.

Making allowances for downtime, moving and other factors affecting the production rate, it is estimated that an average production rate of 1,000 cubic yards of sediment can be dredged per day. For the total 250,000 cubic yards of dredging estimated, this equates to 250 working days or 12 months of actual dredging. With mobilization and demobilization, a total project duration of 14 months is estimated.

VIII. COST ESTIMATE

The costs incurred in completing the entire dredging and dewatering operation is broken down into five major items as follows:

Mobilization - includes complete setup and breakdown of \$50,000 dredger, excavation equipment, and plant and all administration offices. Administration and Engineering supervision fees. Restoration of work areas.

Discharge Piping - includes all labor and material \$16,000 involved in setting up the 8-inch discharge pipe from the Upper Simmons to the dewatering area.

Dredging Upper Simmons Reservoir - includes dredging plant \$1,500,000 daily operation and labor, soundings, sampling, as well as dewatering personnel.

Dewatering Area - includes all material and labor required \$699,200 for the construction of the dewatering area, maintenance and bi-weekly cleaning.

Siltation Fences - includes all materials, installation and maintenance of siltation fences within the Upper Simmons Reservoir.

\$19,000

The total cost of the above items, plus 10% profit, 10% overhead, and 5% contingency is \$2,855,250. Refer to cost estimate in Appendix B.

IX. CONCLUSION

The Lower Simmons Reservoir was void of any observable sediment deposits and requires no dredging. Removal of sediment deposited in the Upper Simmons Reservoir as a result of the landfill erosion will require the dredging of approximately 250,000 cubic yards.

Sediment sources other than the landfill were also found to contribute to the present levels situation, although the extent of their contribution was not determined. These outside sources include borrow pits and unstabilized soil areas in close proximity to both Upper and Lower Simmons Reservoirs. RISWMC is continuing an aggressive erosion and sediment control program. As the total amount of sediment is decreased, the off-site sediment sources will appear to be more significant.

The primary source of sediment from the landfill is the "chute". Soil stabilization and permanent drainage structures need to be installed at the chute if future dredging of the reservoir is to be avoided. Present measures being installed that will help prevent future sedimentation include:

- Vegetation of existing landfill to reduce runoff and erosion.
- Connection of pond 4 to present drainage discharge paths:

- New expansion of the landfill will reduce runoff from the north end of the Quarry Stream Valley.
- Relocation and stabilization of Quarry Stream.

Sediment removal in accordance with the tolerances set forth by the DEM Consent Agreement, dated July 24, 1991, appears impractical. The required removal of 1 inch thickness of sediment is not feasible for any commercially available equipment. A 6-inch minimum depth is more probable. Some dredging of the existing organic strata beneath the sediment will occur. Field controls will be implemented to minimize the amount of natural sediments removed.

Due to the quantity, required tolerance and type of sediment encountered, it appears that hydraulic dredging would be the best method of removal. A hydraulic horizontal auger dredge that can operate in shallow water should be employed to remove the sediment from the Upper Simmons Reservoir. The dredge should contain the following specifics:

- 1. 2,000 gallon per minute dredge pump
- 2. 21-inch draft
- 3. 8-inch suction diameter
- 4. 8-inch discharge pipe diameter

The dredge should be capable of dredging to a required depth over a specified area located by optical and/or electronic survey equipment. Dredge depths throughout the

entire Upper Simmons Reservoir will be determined by the Contractor following an extensive sampling and sounding program.

Mechanical machinery may be used from Shun Pike along Cedar Swamp Brook to the northern end of the reservoir. A 40-foot easement is needed from the Shun Pike to the reservoir along assessor's plot 31, lot 2 (Tillinghast) and lot 6 (Sylvestri) to allow for the dredge discharge pipe and to allow cleaning of Cedar Swamp Brook.

The dredge material will be excavated from the bottom of the reservoir and pumped approximately 1.5 miles upland to a dewatering and spoil area located at the southwest corner of the landfill property. The dredge discharge piping route will follow Cedar Swamp Brook, go beneath Shun Pike in the existing culverts, and then follow the existing landfill roads.

The dewatering basins will utilize check dams and silt barriers. Flocculants are recommended to keep the turbidity of effluent from the basins to a minimum. The basins will be cleaned periodically to ensure proper functioning. The outlet water from the spoils area will enter existing sedimentation Pond 1, and then flow via Cedar Swamp Brook to existing sedimentation Pond 2. The entire dredging operation should have minimal effect on daily landfill operations.

APPENDIX A

BORING LOGS

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- i				Size						Complete	-	28/92		
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	ATION OF	BORING	On	Water	. Simm	ons U	loper Res	servoir.	5' of Water					
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то М	aquire (Group, Inc.							Mass.		HOLE NO.	J-7		
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. At		after	Hour	s Type	9		BW	S/S		Start	4	/28/92		
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LOC	ATION OF	BORING	On	Water	. Simn	ons L	Jpper Res	servoir.	7' of Water					
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то М	anuire (Group, Inc.							Mass.		HOLE NO. <u>U-8</u>	l l		
3HOJE	CT NAME	Pond Sedir	nent Ir	rvestic	ation				n. R.I.		PROJ. NO			
		o <u>above</u>					NO.		-		SURF. ELEV. S		SURI	<u> </u>
-		ATER OBSERVA	TONS						CORE BAR.		D/	ATE.		
A+	•	after	Hour	s Type	<u>.</u>		BW	9/9		Start	4/2	9/92		
·^` —	-	&I(O1	nous	Size						Complete		9/ 92		1
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LOC	TION OF	BORING	<u>On</u>		Simn ows per		pper Res	Strata	5.5' of Water	ROCK IDENTIFI	CATION			
ا ا	Casing	Sample Depths	Туре	or	Sample	er e	Moisture					S	MPLE	.
Depth	Blows per foot	From - To	of Sample	From 0-6	6-12		Density or Consist.	Elev./	Remarks include Rock-color, typ	e, condition, har	dness, drilling	No.	Pen"	Rec "
		0.0-4.8		Pushed		12-10		Depth	Gray SILT, Landf		· / /	1	58	20
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	ple Type Prive C=0	Cored W=Wash	ed	•	ortions U		Cohesioni		o. Wt x 30" fall on a nsity Cohesiv		,	<u>ی.</u> urth Bo		
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OE = Open End Rod and 35 to 50% 30-50 Dense 8-15											HOL	E NO.	U	-8

SROUND SURFACE TO Top of Silt Sample Type D=Drive C=Cored W=Washed UP=Fixed Piston UT=Shelby Tube TP=Test Pit A=Auger USED BW CASING: THEN Spoon to 2.2' 140 lb. Wt x 30' fall on 2' 0.D. Sampler 140 lb. Wt x 30' fall on 2' 0.D. Sampler Cohesionless Density Cohesive Consistency little 10 to 20% some 20 to 35% 10-30 Med. Dense 4-8 M./Stilf Samples 1			100	GU	ILD I R STR	ORIL EET	LINC	G CO., ST PROVI	INC. DENCE,	R.I.		SHEET1_	_ OF	1	
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At after House Hammer Will JA00 By Both Forestan Paul Brescla Dave Naccl Location of Boring Depth Page of Prom To Sample Depth Blows Perfor To Constitute Page 10 Depth Prom To Sample Depth Depth Depth Prom To Depth D	¥t		after	_ Hour						•	l .				
Hammer Fall SQP Inspector/Engl: Dave Nacci	At		after	Hour	1			1/6			1 7			a .	
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Proportions Used UP=Fixed Piston UT=Shelby Tube TP=Test Pis A-Buger Summer Summary Summar	ļ .							į	00-	Dash Oll T	///	<u>/ / / /</u>			
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UP=Fixed Piston UT=Shelby Tube little 10 to 20% 0-10 Loose 0-4 Soft 30 + Hard Rock Coring	, D=C	rive C=(•			Cohesion			•				
Some 2010 Con Samples				Tube	little	10 to	20%					30 + Hard R	ock Co	ring _	
OE = Open End Rod and 35 to 50% 30-50 Dense 8-15 Stiff * 300# hammer	OE :	Open E	nd Rod					30-50	De	nse 8-15	Stiff				<u> </u>

		100	WATE	RSTR	EET •	EAS	ST PROV	DENCE	, R.I.		SHEET 1	_ OF	1	
: 10 M	aquire (Group, Inc.				LADD	BESS F	oxboro.	Mass.		HOLE NO. U-	10		
PROJE	CT NAME	Pond Sedin	nent Ir	rvestic	ation				1. R.I.		PROJ. NO.			
		o above		•		1	R JOB NO.		-		SURF. ELEV.		SURI	? <u>. </u>
√ GR	OUND W	ATER OBSERVAT	TONS					SAMPLER			D	ATE		
1.		after	Ноли	s Type	•			_S/S_		Start	A/2	9/92		- 1
		and	1100#	Size						Complete		9/92		
At		after	Hour	1.	nmer Wt.			140#		Boring Foreman				
_				Han	nmer Fall	_		30"	· ——	Inspector/Engr.				
1.00	TON 05	DODINO		Motor	Cimm	one I	Innor Do		1 T of Motor				• • • • • • • • • • • • • • • • • • • •	
LOCA		BORING			ows per 6		T	Strata	1.7' of Water	ROCK IDENTIFIC	CATION	T		
Depth	Casing Blows	Sample Depths	Type of	From	Sampler	r	Moisture Density or		l			S	MPLE	1
оори	per foot	From - To	Sample			12-18	Consist.	Elev./ Depth	Remarks include Rock-color, typ	e, condition, hard time, seams, etc.	dness, drilling	No.	Pen* F	iec."
- 		0.0-4.7	D	Pushed				Dopur	Gray SILT, Landi		. / / /	1	56	16
1							1		///	/ / /	///			
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						•••••		3.0	Dark Brown fibro	us PEAT		1A		
١ .								4.0	Gray fine to med	lium SAND				
								4.7	Bottom o	f Boring 4.7'		1		
								- /						
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t									Note: 3.0' Landi	fill sediment obse	erved/estimated		1	
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	IND C: IC	FACE TO Tom	of Cile	1	<u></u>	ICED !	Snco=	CACINIO	THEN				1	L
•	JNO SURI ple Type	FACE TO Top (<u> </u>	Pron	ortions Us		Spoon		D. Wt x 30" fall on :	2° O.D. Sampler	I	SL	JMMAF	<u> </u>
D=0	rive C=(Cored W=Wash		trace	0 to		Cohesion	ess De	nsity Cohesiv	e Consistency		arth Bo	-	
	Fixed Pis Test Pit A	ton UT=Shelby	Tube	little	10 to	20%	0-10 10-30		ose 0-4 Dense 4-8	Soft M./Stiff	30 + Hard R	ock Co	ring	
, OE	= Open E	nd Rod		some and	20 to 35 to		30-50	De	nse 8-15	Stiff		amples		
* 30)# hamm	er	l				50+	Very	Dense 15-30	V-Stiff	HOL	E NO.	U-1	10

	er, en	100	GU	ILD I	ORILI EET	LING • EA	G CO., ST PROVI	INC.	, R.I.	** .	SHEET1	OF		1
to M	aguira (Group Inc				LADI	DDESS E	ovhoro	Mace		אטובאס 1			l
	CT NAME	Pond Sedin	nent li	nvestic	ation						_			
,			IIVIII II	1100119	MINA									RF
			TONS							T	COIT . CELV.			-
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At		after	Hour	1 **				•		1				
		-4	Lla	1 -		_			1	1 '				—
At		arter	nour			-		Pusneo	BIT	-				
				Пал	imer rai					inspector/Engr	·	Iacci_		
LOCA	TION OF	BORING	<u>On</u>	Water	. Simm	ons l	ower Re	servoir.	2' of Water					
	Casing	!	Type	Blo	ows per 6	5"	Moisture	Strata	SOIL OR	ROCK IDENTIFI	CATION	T		
Depth	Blows		of	From			Density or		Remarks include	color, gradation,	type of soil etc	s. S	AMPL	E
•	per foot	From - 10	Sample	0-6	6-12	12-18	Consist.		Rock-color, typ	e, condition, har time, seams, etc	dness, drilling	No.	Pen"	Rec."
		0.0-1.8	D	Pushed		.							22	6
TO WASCUIPE GROUND INC.														
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	O Maguire Group, Inc. SOURCE HAVE Pond Sediment Investigation Locanon Albinetion, R.I. SOURCE HAVE Pond Sediment Investigation Locanon Albinetion, R.I. SOURCE HAVE Pond Sediment Investigation Locanon Albinetion, R.I. SOURCE HAVE POND SEDIMENT CORE BAR A ster Hours Type Size S. SST Compile Al30/92 Size ID. 1-3/85 Compile Al30/92 Size ID. 1-3/85 Start Al30/92 Compile Al30/92 Compi													
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								1	Note: No surficia	al landfill sedime	nt observed			
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GROU	IND SURF	ACE TO 1.8'				ISED	Spoon	CASING:	THEN					
			1	Рторо			1	140 lt	o. Wt x 30" fail on 2	2" O.D. Sampler		<u>s</u>	<u>UMM</u> A	<u>.RY:</u>
TO MAQUIFE GROUP, Inc. PROJECT RAME POID SEGMENT INVESTIGATION A		<u>1.8'</u>												
		-	upe								JU + MAIO	1		
OE =	Open E	nd Rod					30-50		nse 8-15	Stiff	[
- 300	r≠ namm	er	1				50+	very	Dense 15-30	V-Stiff	; H	JLE NU.	L	

		. 100	GU	ILD I	DRIL EET	LING • EA	G CO., ST PROVI	INC.	. R.I.		SHEET1	OF		<u> </u>
ro M	aquire (Group, Inc.							Mass.		HOLE NOL	-2		
ROJE	CT NAME	Pond Sedir	nent Ir	rvestic	ation	_ LO			n. R.I.		PROJ. NO			
		o <u>above</u>					R JOB NO.				SURF. ELEV.			UF.
GF	OUND W	ATER OBSERVAT	TONS			С	ASING :	SAMPLER	CORE BAR.			DATE		
At	4	after	Hour	s Typ	8			S/S		Start	4	/30/92	!	
	-			1	I.D.			1-3/8"		Complete		/30/92		
At	•	after	Hour	s Han	nmer Wt			Pushed		Boring Foremar	P. B	rescia		
				Han	nmer Fal	I				Inspector/Engr.	D. N	acci_		
LOC	ATION OF	BORING	On	Water	. Simn	nons l	ower Re	servoir.	3.7' of Water					
	Casing		Time	Ble	ows per	6"	Moisture	Strata		R ROCK IDENTIFIC	CATION			_
epth	Blows	Sample Depths From - To	Type of	From	n Sample	er Fo	Density or	Change	Remarks include	color, gradation,	type of soil etc.	. S	AMPL	E
-	per foot	Fiom - 10	Sample	0-6	6-12	12-18	Consist.	Elev./ Depth	Hock-color, typ	color, gradation, be, condition, hard time, seams, etc.	iness, arilling	No.	Pen"	Rec."
2 . A.A.A.		0.0-1.8	D	Pushed					Dark Brown silty	Organic PEAT		1	22	6
													ļ	.,
		·						1.8	Bottom o	f Boring 1.8'				
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								,	No. 0 4 81 4		04ND			
,									Note: @ 1.8 - C	Gray medium to fi	HE SAND			
•									Note: No surfic	cial landfill sedime	ent observed			
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		FACE TO <u>1.8'</u>					Spoon		THEN				10.40.44	DV:
	ple Type	Cored W=Wash	ed	•	ortions L		Cohorisal		o. Wt x 30" fall on nsitv Cohesi	· ·			<u>UMMA</u>	
UP=	Fixed Pis	ton UT=Shelby		trace little		10%	CohesionI 0-10	Lo	ose 0-4	Soft		Earth Bo Rock Co		1.0
`πP=	Test Pit A	\= Auger		some	20 to	35%	10-30 30-50		Dense 4-8 ense 8-15	M./Stiff Stiff		Sample		
* 30	= Open = 0# hamm	er		and	35 to	50%	50+		nse 6-15 Dense 15-30		Гно	DLE NO.	L	-2

• :			GU	LD [R STR	ORIL	LINC	G CO., ST PROVI	INC.	, R.I.		SHEET1	OF	1	
то М	aquire (Group, Inc.				LADE	BESS F	oxboro.	Mass.		HOLE NOL	-3		İ
SONE	CT NAME	Pond Sedir	nent Ir	vestic	ation				n, R.I.		PROJ. NO			
		o <u>above</u>					R JOB NO.				SURF. ELEV.			F.
GP	OUND W	ATER OBSERVAT	TONS			C	ASING :	SAMPLER	CORE BAR.	T		DATE		
٩ŧ		after	Hour	s Type	.			S/S		Start	4,	/30/92	1	
1					I.D.			1-3/8"		Complete	•	/30/92		
At		after	Hour	s Han	nmer Wt.			Pushed	l віт		n <u>P. B</u>	-		
				Han	nmer Fal	<u> </u>				Inspector/Engr	D. N	acci_		
LOC	ATION OF	BORING	On	Water	. Simm	nons L	ower Re	servoir.	2.5' of Water					i
	Cacina		Type	Blo	ows per	6"	Moisture	Strata		R ROCK IDENTIFI	CATION		A 1 4 CV .	
epth	Blows	Sample Depths From - To	of	From	Sample	er Γo	Density or	Change Elev./	Remarks include	color, gradation be, condition, har time, seams, etc	type of soil etc.	. L°	AMPLE	
į	per foot	Pioni-10	Sample	0-6	6-12	12-18	Consist.	Depth	HOCK-COIOF, typ	time, seams, etc	uness, unling	No.	Pen*	Rec."
		0.0-1.7	D	Pushed					Dark Brown san	dy Organic PEAT		1	21	6
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								1.7	Bottom of	Boring 1.7'				
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•									Note: @ 1.7' -	Gray medium to	fine SAND		Ì	
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									Note: No su	rficial landfill sed	iment observed			
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,		FACE TO <u>1.7'</u>					Spoon			MOD 0: 1			UMMA	BY.
	ple Type Drive C=0	Cored W=Wash	ed	•	ortions C		Cohesion		b. Wt x 30" fall on nsityCohes		,	Earth B		
UP=	Fixed Pis	ton UT=Shelby		trace little	10 to	10% 20%	0-10	Lo	oose 0-4	Soft	30 + Hard	Rock Co		
	Test Pit / = Open E			some and		35% 50%	10-30 30-50		Dense 4-8 ense 8-15			Sample		 .
· * 30	0# hamm	er	İ	ai fu	35 K	JU%	50+		Dense 15-3		lно	OLE NO.	L	-3

<u>`</u>		100	GU WATE	ILD I	DRIL EET	LINC • EAS	G CO., ST PROVI	INC.	, R.I.		SHEET1	OF		1
то М	aquire (Group, Inc.					BESS F	oxboro	Mass.		HOLE NOL	-4		
		Pond Sedir							n. R.I.		PROJ. NO			
	T SENT T		inalit ii		SIN 21		R JOB NO.		-		SURF. ELEV.			RF
		ATER OBSERVA	TIONS	Ī				SAMPLER		T	OOI a . LLL V.	DATE		-
!						•								
At		after	Hour	1				S/S		Start		/30/92		
ŀ				Size		_		1-3/8"		Complete		/30/92		
At		after	Hour		nmer Wt.	_		<u>Pushed</u>	BIT	Boring Forema		rescia		
	•			Han	nmer Fal					Inspector/Engr	D. N	lacci		<u>:</u>
Loca		BORING	On	Water	Simm	one I	ower Per	convoir	1.5' of Water		-			
100/		BORING	1		اااااات Ows per (Strata		ROCK IDENTIFI	CATION	Ţ		
Danth	Casing	Sample Depths	Туре	or	n Sample	er	Moisture	Change				. \$	SAMPL	E
Depth	Blows per foot	From - To	of Sample	From 0-6	1 6-12	o 12-18	Density or Consist.	Elev./	Remarks include Rock-color, typ	e, condition, har	dness, drilling	"	Don!	Dec.
	porioot		<u> </u>	•		12-10	OUISIS.	Depth					Pen*	+
'		0.0-1.3	D	Pushed					Dark Brown silty	Organic PEAT		1	16	4
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								1.3	Bottom o	of Boring 1.3'		ヿ		
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									Note: @ 1.3' - B	rown tine to med	IIUM SAND			
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		-		•					Note: No surficia	al landfill sedime	ent observed			
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CES	IND OF IO	ACE TO 4 2'	1	1		iece 4	Encor	CACINIC	I					
		FACE TO <u>1.3'</u>		D			Spoon		THEN	ZOD Sample-			UMMA	RY:
	ple Type rive C=0	Cored W=Washe	ed	•	ortions U		Cohesionle		o. Wt x 30" fall on a nsity Cohesiv		,	Earth B		
UP=	Fixed Pis	ton UT=Shelby		trace little	10 to	10% 20%	0-10		ose 0-4	Soft	30 + Hard	Rock Co		_لايا_
	Test Pit A Open Ei			some	20 to	35%	10-30 30-50		Dense 4-8 ense 8-15	M./Stiff Stiff		Sample		
	# hamm			and	35 to	50%	50+		nse 8-15 Dense 15-30	V-Stiff	Гно	OLE NO.	L	-4

		100	GU WATE	ILD (DRILL EET •	INC	G CO., ST PROVI	INC. DENCE	, R.I.		SHEET1	OF		-
о м	aquire (Group, Inc.				ADE	DRESS _FO	oxboro.	Mass.		HOLE NO. L	-5		
POJE	CT NAME	Pond Sedin	nent Ir	rvestiç	ation		CATION J				PROJ. NO			
POP	T SENT T	o <u>above</u>				OUI	R JOB NO.	92-156			SURF. ELEV	SED	<u>. su</u>	RF.
GR	OUND W	ATER OBSERVAT	TONS			C	ASING S	SAMPLER	CORE BAR.			DATE		- 1
it		after	Hour	s Type	A			S/S_		Start	4/	30/92	!	
*		a			i.D.					Complete		30/92		
At		after	Hour		nmer Wt.			Pushed		Boring Forema		rescia		
				Han	nmer Fall					Inspector/Engr	D. N	acci		
:								_ •	0.01 - (111 - 1 -	<u>.</u>				
LOC	ATION OF	BORING	<u>On</u>		<u>, Simm</u> ows per 6		ower He	Servoir, Strata	2.8' of Water	ROCK IDENTIFI	CATION			
	Casing	Sample Depths	Туре	or	n Samplei	•	Moisture	0				8	AMPL	E
epth	Blows per foot	From - To	of Sample	From 0-6		0 12-18	Density or Consist.	Elev./	Remarks include Rock-color, typ	e, condition, har	type of soil etc. dness, drilling	No.	Pen*	Bec "
	per 1001	0.0-2.8			<u> </u>	12-10	00,10,0	Depth	Dark Brown silty		·	1	34	16
		0.0-2.8	D	Pushed			Ì		Dark Blown silly	Organic PEAT		'	-	"
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				!										
-					<u> </u>								1	†
			· .					00-	Pottom o	f Doring 2 8'		- .		
								2.8	Bottom o	f Boring 2.8'				
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	i													
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	<u> </u>								Note: @ 2.8' - G	iray medium to r	ING SAMD			
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									Note: No surfici	ai ianoilli seoirne	ent observed		Ì	
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200	INID C: IT	TAOE TO O O'	J		لبل	ICEC	Specs	CASINO	TUEN	···				
		FACE TO 2.8'		Drac			Spoon		THEN b. Wt x 30° fall on	2º O.D. Sampler		s	UMMA	VRY;
	nple Type Orive C=0	Cored W=Wash	_{bed}	Prop trace	ortions Us	sea 10%	Cohesion		nsity Cohesi		, l	Earth B		
UP=	Fixed Pis	ton UT=Shelby		little	10 to		0-10	Lo	oose 0-4	Soft		Rock C		
	Test Pit / = Open E			some	20 to	35%	10-30 30-50		Dense 4-8 ense 8-15	M./Stiff Stiff		Sample		
	= Open E 0# hamm			and	35 to	50%	50+		Dense 15-30		н	ON 3JC	. L	5

-		100	GUI	LD [ORILI	LING	CO., ST PROVI	INC.	R.I.		SHEET1_	OF	1	<u> </u>
ro M	anuira (Group, Inc.							Mass.		HOLE NO. L	-6		
BOYE.	CT NAME	Pond Sedin	nent In	vestio	ation				1, R.L.		PROJ. NO.			
	T SENT T						JOB NO.	92-156			SURF. ELEV.	SED.	SU	UF.
GR	OUND W/	ATER OBSERVAT	TONS			CA	USING S	SAMPLER	CORE BAR.			DATE		
At		after	Hours	з Туре	•			S/S		Start	•	30/92		
				Size				1-3/8"	_	Complete		30/92		—
At		after	_ Hour	1	nmer Wt. nmer Fall			<u>Pushed</u>	BIT	Inspector/Engr	n <u>P. Bı</u> . <u>D. N</u> .			
				пал	IIII er Fau					IIIspector/Lingi		avvi		
LOC	TION OF	BORING	_On				ower Res		2' of Water					
	Casing	Sample Depths	Туре	Or	ows per 6 Sample	r	Moisture	Strata Change		R ROCK IDENTIFI		s	AMPL	E
æpth	Blows per foot	From - To	of Sample	From 0-6	T- 6-12	o 12-18	Density or Consist.	Elev./	Rock-color, ty	e color, gradation, pe, condition, har time, seams, etc	, type of soil etc. dness, drilling	No.	Pen"	Bec.
		0.0-1.8		Pushed	1012	12-10		Depth	Dark Brown silty		•	1	22	10
		0.0 1.0								, 0				
						•••••••								
								1.8	Bottom	of Boring 1.8'				
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									Note: @ 1.8' - 0	Gray medium to f	ine SAND			
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l									Note: No surfic	cial landfill sedime	ent observed			
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İ										8' - Gray medium to fine SAND urficial landfill sediment observed				
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		FACE TO <u>1.8'</u>	1	Droc			Spoon			n 2" O.D. Sampler		s	UMM/	NRY:
D=1		Cored W=Wash		trace	ortions U 0 to	10%	Cohesion	less De	nsity Cohes	sive Consistenc	;y	Earth B	oring .	
1	Fixed Pist Test Pit	ston UT=Shelby A=Auger	Tube	little some	:	20% 35%	0-10 10-30		oose 0-4 . Dense 4-8		30 + Hard	Rock Co Sample		
Œ	= Open E 0# hamm	ind Rod		and	35 to		30-50 50+	D	ense 8-15 Dense 15-3	5 Stiff	H	OLE NO.		6
- 30	ur namin	ici	ļ				. 507	**************************************	_555				_	

		100	GU	ILD I	DRIL	LING	G CO., ST PROV	INC.	R.I.			SHEET 1	OF		1
ro M	aguira (Group, Inc.					DRESS F					HOLE NO. L	. 7		
	CT NAME	Pond Sedir	nent Ir	vestic	ation		CATION _					PROJ. NO			
	T SENT T				MUSII	OU	R JOB NO.					SURF. ELEV.			UF.
		ATER OBSERVA	ΠONS					SAMPLER		BAR.			DATE		
	_	-4	Lla.m		_			0/0			Start	A /	30/92	,	
Ατ		after	nour	s Typo Size				<u>S/S</u> 1-3/8"			Complete	•	30/92 30/92		
At	•	after	Hour		nmer Wi	_		Pushed			•	n <u>P. Br</u>			
					nmer Fa		·····	<u>, , , , , , , , , , , , , , , , , , , </u>		1	Inspector/Engr				
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LOC	ATION OF	BORING	<u> On</u>				ower Re				DOOK IDENTIFIE	OATON			
	Casing	Sample Depths	Туре	or	ows per n Sampl	er	Moisture	Strata Change	_		ROCK IDENTIFI		8	SAMPL	E.
Depth	Blows per foot	From - To	of Sample	From 0-6	6-12	To 12-18	Density or Consist.	Elev./	Rock-co	olor, type	color, gradation, e, condition, har me, seams, etc	type of soil etc. dness, drilling	No.	Pen*	Rec.
		0.0-3.8	D	Pushed	1			Depth	Dark Bro			•	1	46	18
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GRO	JND SUR	FACE TO 3.8'				USED	Spoon		THEN					- 45	
	ple Type		. 1	Prop	ortions (1				O.D. Sampler		_	SUMMA	
		Cored W=Wash ton UT=Shelby		trace		10%	Cohesion 0-10		nsity ose	Cohesive 0-4	e Consistenc Soft		Earth B Rock C		3.8
! TP≃	Test Pit	A=Auger		little some		20% 35%	10-30	Med.	Dense	4-8	M./Stiff	1	Sample		
	= Open E 0# hamm		-	and	35 to	50%	30-50 50+		nse Dense	8-15 15-30	Stiff V-Stiff		ON 3JK		7

		100	GUI	LD [DRIL	LING EAS	G CO., ST PROVI	INC. DENCE,	R.I.		SHEET1_	_ OF		<u> </u>
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NE	CT NAME	Group, Inc. Pond Sedin	nent In	vestic	ation				n, R.I.		PROJ. NO			
	T SENT T		, 2111	722113			JOB NO.				SURF. ELEV.			F.
		TER OBSERVAT	TONS	1				SAMPLER	CORE BAR.			ATE		
		after	House		•			Hand		Start	4/:	30/92)	
τ	•	alter	nouis	: Type Size						Complete		30/92		
At		after	Hours	I - '	nmer Wt.	_		<u> </u>		1 -	n P. Br			
			_	- 1	nmer Fall					Inspector/Engr	D. Na	cci		
LOC	ATION OF	BORING	On	Water	. Simm	ons L	ower Re	servoir.	1' of Water	J				
	Casina		Туре	Ble	ows per (3"	Moisture	Strata		ROCK IDENTIFI	CATION	Ι,	AMDU	_
pth	Blows	Sample Depths	of	or From	Sample	r O	Density or	Change	Remarks include	color, gradation	type of soil etc.		AMPLI	
•	per foot	From - To	Sample	0-6	6-12	12-18	Consist.	Elev./ Depth	Remarks include Rock-color, typ	time, seams, etc	aness, aniling ·	No.	Pen"	Rec.*
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	onio soni iple Type		1	Pron	ortions U	_	!		b. Wt x 30" fall on	2" O.D. Sampler	ı	Ş	UMMA	RY:
		Cored W=Wash	ed	trace		10%	Cohesion		nsity Cohes	ve Consistenc	y	Earth B	oring _	0.3'
		ton UT=Shelby	Tube	little	10 to	20%	0-10		ose 0-4 Dense 4-8	Soft M./Stiff	30 + Hard	Rock C	oring	
	:Test Pit / = Open E			some and		35% 50%	10-30 30-50		nse 8-15	Stiff		Sample		
	0# hamm		1	- ·	55 10		50+	Verv	Dense 15-3		Іно	LE NO	. L	8

			100	WATE	RSTR	JKILI FFT (LINC FAS	ST PROVI	INC.	R.I.		SHEET1	OF	1	
				******								HOLENO I	0		
TC	M	aguire s	Pond Sedin	oont In	wootio	ation				Mass. n. R.I.		HOLE NOL PROJ. NO			
				ICILLII	ivesilâ	auvii		R JOB NO.				SURF. ELEV.		SII	R TP
-SE			O <u>above</u> ATER OBSERVAT	TONIC					SAMPLER			OOTH . ELEV.	DATE		-
	GH	JOIND WAY	(IEH OBSERVA)	IONS	j		O,	WING .	OMVII LELI	OONL BAIL					
p	\t		after	_ Hours	Type	•			<u>S/S</u>		Start		/30/92		
i					Size	I.D.	_		<u>l-3/8</u>		Complete		/30/92		
1	\t	· · · · · · · · · · · · · · · · · · ·	after	_ Hours	s Harr	ımer Wt.			<u>Pushed</u>	BIT	Boring Forema		rescia		
					Ham	nmer Fal	ــــ				Inspector/Engr	D. N	lacci		
_		TON OF	DODING		Water	Simm	one I	ower Re	cenvoir	1' of Water				•	
느	LOCA	TION OF	BORING			ows per (Strata	SOIL OF	ROCK IDENTIFI	CATION	T		
'n		Casing	Sample Depths	Type	or	Sample	er Fo	Moisture Density or	l	1			. S	AMPLE	-
ט	epth	Blows per foot	From - To	of Sample	From 0-6	6-12 T	12-18	Consist.	Elev./	Remarks include Rock-color, typ	e, condition, har	dness, drilling	No.	Pen"	Rec."
L			0.0-2.8		Pushed	012	12-10		Depth	Dark Brown fibro		•	1	34	12
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			FACE TO <u>2.8'</u>					Spoon		****	OLO D. O		, 9	UMMA	RY:
1	Sam	ple Type	Cored W=Wash	ed	-	ortions (Cohesion		b. Wt x 30" fall on nsity Cohesi			Earth B		-
			cored w=wash ton UT=Shelby		trace little	-) 10%) 20%	0-10		oose 0-4	Soft	30 + Hard	Rock Co		<u> </u>
1	₽≃	Test Pit	A=Auger		some	20 to	35%	10-30		Dense 4-8	M./Stiff		Sample		
1		= Open E 0# hamm			and	35 to	50%	30-50 50+		ense 8-15 Dense 15-30		Н	OLE NO.	L	-9

		GUILD DRILLING CO., INC. 100 WATER STREET • EAST PROVIDENCE, R.I.													
· m M	anuira (Group, Inc.					DRESS _F	,				HOLE NO. L-	10		
		Pond Sedin	nent In	vestic	ation		CATION J					PROJ. NO.			
	T SENT T					1	R JOB NO.		-			SURF. ELEV		SUI	F.
GR	OUND W	ATER OBSERVAT	TONS		•	C	ASING S	SAMPLER	CORE	BAR.			DATE		
At		after	Hours	Тур	9			S/S			Start	4/	30/92		
				1	I.D.			•				4/	30/92		
At		after	_ Hours	Han	nmer Wit			<u>Pushed</u>	ВП						—-I
				Han	nmer Fal	l					Inspector/Engr	D. Na	CCI		
LOC	ATION OF	BORING	On	Water	. Simn	nons l	ower Re	servoir.	1' of Wa	ater					
	Casing		Туре	BI	ows per	6"		Strata			ROCK IDENTIFI	CATION		AMP	F
Depth	Blows	Sample Depths From - To	of	From		To	Density or	Change Elev./	Remarks	include c	color, gradation,	type of soil etc.	_		
	per foot		Sample	0-6	6-12	12-18	Consist.	Depth							
		0.0-3.3	D	Pushed					Dark Bro	wn silty C	Organic PEAT		1	40	8
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		FACE TO 3.3'	·				Spoon						-	1 18.48.47	RV.
	ple Type Drive C=0	Cored W=Wash	ed		ortions L		Cohesion								
UP=	Fixed Pis	ton UT=Shelby		trace little		10% 20%	S/S 1-3/8* Pushed BIT Complete 4/30/92 Boring Foreman P. Brescia Inspector/Engr. D. Nacci Ower Reservoir, 1' of Water Moisture Change Elev./ Consist SOIL OR ROCK IDENTIFICATION Depth SOIL OR ROCK IDENTIFICATION Depth Change Elev./ Depth Dark Brown silty Organic PEAT SOIL OR ROCK IDENTIFICATION Depth SAMPLE Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling No. Pen' Nec.' No. Pen' Nec.' 1 40 8 Note: @ 3.3' - Brown fine to medium SAND Note: No surficial landfill sediment observed								
	Test Pit / = Open E			some		35% 50%							Sample		
	0# hamm		-	and	JO ((J 50 %	1					Но	LE NO	L	-10

POR GR	T SENT T	Pond Sedin Oabove ATER OBSERVAT	nent in	vestig Type Size Ham	ation_	EAS	R JOB NO. ASING	DENCE, oxboro, lohnstor	Mass. n, R.I. CORE BAR.			SED. DATE 80/92 80/92	SUR	
LOC/	Casing Blows per foot	BORING Sample Depths From - To	On Type of Sample	Water,	Simm	ons L	Moisture Density or Consist.	Strata Change Elev./		R ROCK IDENTIFIC color, gradation, se, condition, hard time, seams, etc.	CATION	s	AMPLI	
	period	0.0-3.3		Pushed	6-12	12-18	Consist.	Depth	Dark Brown san			1	40	16
								3.3		n of Boring 3.3'	lium SAND			
									Note: No surfic	ial landfill sedime	ent observed			
											-			
Sam D=0 UP= TP= DE	ple Type Drive C=	nd Rod	1	Propo trace little some and	ortions U 0 to 10 to 20 to		Spoon Cohesion 0-10 10-30 30-50 50+	140 II less De Lo Med. De		Soft M./Stiff Stiff	y 30 + Hard	Sarth Barock Co Sample	oring s 1	_

		100	GUI	LD I R STR	JRIL EET	LINC • EAS	3 CO., ST PROV	INC. IDENCE,	R.I.			SHEET1	OF	_1	
ro _M.	aquire C	aroup, Inc.							Mass.			HOLE NO. L	-12		
PROJE	T NAME	Pond Sedin	nent In	vestiç	ation		L NOITA					PROJ. NO			_
	T SENT TO						JOB NO.			AD T	<u> </u>	SURF. ELEV.	DATE	SUK	r.
GR	OUND WA	ITER OBSERVAT	nons			C	ASING	SAMPLER	COHE B						
At		after	_ Hours	1 -				<u>S/S</u>			tart		/30/92		
•		-H	Ll a. m.	- 1	ı I.D. nmer Wt.			1-3/8" Pushed		_	omplete oring Foremar		/30/92 rescia		
Αί		after	Hours		nmer Fal			1 USHEU	BIT		spector/Engr.				
LOCA	TION OF	BORING	<u>On</u>		, Simmows per		1	Servoir, Strata	0.8' of W		OCK IDENTIFIC	CATION			
04	Casing	Sample Depths	Type of	OI	n Sample	er Fo	Moisture Density or	1					S	AMPLE	=
Depth	Blows per foot	From - To	Sample	From 0-6	6-12		Consist.	Elev./ Depth	Rock-col	lor, type, tin	condition, harde, seams, etc.	type of soil etc. iness, drilling	No.	Pen"	Rec."
		0.0-3.8	D	Pushed	<u> </u>			- Bopur			ganic PEAT		1	46	12
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		FACE TO 3.8'					Spoon	_ CASING:			000		, «	UMMA	NRY:
	ple Type	Cored W=Wash	ed	_	oortions l		Cohesion			fall on 2° Cohesive	O.D. Sampler Consistence		Earth B		
UP:	Fixed Pis	ton UT=Shelby		trace little	10 t	o 10% o 20%	0-10	Lo	oose	0-4	Soft	30 + Hard	Rock C		
	Test Pit a Open E			some	20 t	o 35% o 50%	10-30 30-56	•	. Dense ense	4-8 8-15	M./Stiff Stiff		Sample		
	O# hamπ			and	30 t	J 500 70	50+		Dense	15-30	V-Stiff	l H	OLE NO	. L	-12

APPENDIX B

COST ESTIMATE



Maguire Group Inc. Architects/Engineers/Planners

COST ESTIMATE

225 Foxborough Boulevard Foxborough, Massachusetts 02035

PROJECT RISWIMC DREDGING + DEWATERING
SUBJECT UPPER SIMMONS RESEVOIR

BUDGET	JOB NO. <u>/3488</u> DATE
PRELIMINARY	DATE 6/15/72
FINAL	BY JMM
	CKD

TEM DECODIDATION	QUANTITI	FS	EQUIPI	MENT	l	MATERIAL	L	LABOR		TOTAL COST
ITEM DESCRIPTION	QUARTITI	UNIT		VIII I	UNIT		UNIT COST		UNIT COST	
MOBILIZATION		12							40 K	40,000
restoration	1	45			1		_		10 K	10,000
[E3.046.194)							subtut	50,000		
DISCHARGE PIPING	8000	LF					_		2	16,000
TSCHALOL TO THE					.		546161	16,000	6	1,500,000
DREDGING	750,000	CY					_	1 0 1 1 1		7, 300,000
							Subtet	1,500,000	 	
DEWATERING AREA		1							4.5	36,000
excauation	४०००	CY							4.5	90,000
embank ment	70,000	CY			-				1.0	78,000
Grading + Compaction	78,000	CY			-				10 K	10,00
outlet structures	L	22	ļ						150	7.500
	50	tons	 			 			1.0	1,700
Rip Rap filter fabric	1700	Sy	 						10	10.000
SIA Bayviers	1000	LF		<u> </u>		<u> </u>			1500	6,000
hydroseeding	Ч	ac	 				_		10 K	10,000
Floculation		LS	 		-	 			25 K	500,000
biweekly Gleaning	20	EA			_	<u> </u>	SUblut	699,200		
	<u> </u>									
SILTATION FENCES	2	EA	· 		_				500	1000
Remove existing senses	1200	LF	-						15	18,000
install, anchor + maintain New	1200						20010	19,000	 	
		-					TOTAL	2,284,200	TOTAL	2,284,2
		 								
10% Prof: +		1	11-					228.420	<u> </u>	
10% overpers	 	1	1					228,420	<u> </u>	
10 10 overhere	 	1	1					114,210		
5% contingency							_	ļ	-	-
		-				 		 	-	<u> </u>
		-								
										
TOTAL	 					 	_	2,855,250	,	2855.3

APPENDIX C CHEMICAL ANALYSIS

ALPHA ANALYTICAL LABORATORIES CERTIFICATE OF ANALYSIS

Client: The Environmental Scientific Corp.

Sample Number: 890498.2

Analysis Requested: Listed below

Date Received: 05/26/89

Date Reported: 06/12/89

of Containers: 4

Client Ident: Sediment #1

Sample Location:

Sample Description: Sediment

Sample Container: Glass jars & vials Field Prep: pH>12 for cyanide w/NaOH

pH<2 for metals W/HNO3

pH<2 for TPH w/ HCl

pH<2 for TKN & phosphorous w/H2SO4

- FILE TOT 114. 4 FILE 1								
PARAMETER	RESULT	UNITS	MDL*	INST	REF**	METHOD	EXTRACT	ANALYSIS
Total Metals					1	3050	06/07/89	
Arsenic Barium Cadmium Chromium Copper Lead Mercury Selenium Silver Vanadium Zinc	0.7 42 0.7 ND 7 22 ND ND ND ND 16.9 164	mg/Kg mg/Kg mg/Kg mg/Kg mg/Kg mg/Kg mg/Kg mg/Kg mg/Kg	0.2 5 0.2 2 1 2 0.02 0.2 0.5 0.2	HGA AAS AAS AAS CV HGA AAS ICP AAS	1 1 1 1 1 1 1	7060 7080 7130 7190 7210 7420 7471 7740 7760 6010 7950		06/08/89 06/08/89 06/08/89 06/08/89 06/08/89 06/08/89 06/08/89 06/08/89 06/08/89
% Solids	66	*		Grav	2	209A		06/08/89
EP Toxicity Ext	raction				1	1310	06/07/89	
Arsenic Cadmium Chromium Copper Lead Mercury Nickel Vanadium Zinc	ND 0.010 ND 0.02 ND ND 0.10 0.008 4.13	mg/L mg/L mg/L mg/L mg/L mg/L mg/L	0.00 0.03 0.03 0.03 0.04	2 AAS 5 AAS 005 CV 4 AAS	1 1 1 1 1 1 1 1 1	7060 7130 7190 7210 7420 7470 7520 6010 7950		06/08/89 06/08/89 06/08/89 06/08/89 06/08/89 06/08/89 06/08/89 06/08/89

^{*} MDL-Method Detection Limits (same units as the Results)

^{**} REF-Reference as cited on the cover (first) page of this report.

ALPHA ANALYTICAL LABORATORIES CERTIFICATE OF ANALYSIS

Client: The Environmental Scientific Corp.

Sample Number: 890498.2

Analysis Requested: Listed below

Date Received: 05/26/89

Date Reported: 06/12/89

of Containers: 4

Client Ident: Sediment #1

Sample Location:

Sample Description: Sediment

Sample Container: Glass jars & vials Field Prep: pH>12 for cyanide w/NaOH

pH<2 for metals w/HNO2 pH<2 for TPH w/ HCl

pH<2 for TKN & phosphorous w/H2SO4

CONTINUED

PARAMETER	RESULT	UNITS	MDL*	INST	REF**	METHOD	EXTRACT	ANALYSIS
HSL Acid/Base/Neut Extractables	ral							
Phenol	2,420-	ug/Kg	1*	GC/MS	1.	8270	06/01/89	06/02/89
PCB'S	ND	mg/Kg	0.250) GC	1	8080	06/01/89	06/02/89
Pesticides	ND	mg/Kg	0.05	GC	1	8080	06/01/89	06/02/89
HSL Volatile Organ	nics							
Volatile Halocar	oons ND	ug/Kg	1*	GC/MS	1	8240		06/06/89
Volatile Aromati	CS ND	ug/Kg	1*	GC/MS	1	8240		06/06/89

NOTE: All compounds were below the detection limits except those listed above.

A list of PCB'S and pesticides analyzed for accompanies this report.

^{1*} A list of acid/base neutral extractables and volatile organics analyzed for and their detection limits accompanies this report.

^{*} MDL-Method Detection Limits (same units as the Results)

^{**} REF-Reference as cited on the cover (first) page of this report.

ALPHA ANALYTICAL LABORATORIES CERTIFICATE OF ANALYSIS

Client: The Environmental Scientific Corp.

Sample Number: 890498.2

Analysis Requested: Listed below

Date Received: 05/26/89

Date Reported: 06/12/89

of Containers: 4

Client Ident: Sediment #1

Sample Location:

Sample Description: Sediment

Sample Container: Glass jars & vials

Field Prep: pH>12 for cyanide w/NaOH pH<2 for metals w/HNO3 pH<2 for TPH w/ HCl

pH<2 for TKN & phosphorous W/H2SO4

CONTINUED

	•							
PARAMETER .	RESULT	UNTTS	MDL*	INST	REF**	METHOD	EXTRACT	ANALYSIS
Total Cyanide	ND	mg/Kg	0.4	Spect	2	412B&D		06/06/89
Total Petroleum Hydrocarbons	1,230	mg/Kg	40	IR	2	503B/D/	Æ	06/06/89
Nitrogen Nitrate as N TKN as N	ND 469	mg/Kg mg/Kg		Spect Spect		3-183 3-201D	05/26/89	05/26/89 06/09/89
Total Phosphate					5	3-227	06/09/89	
Phosphorous	1.8	3 mg/Kg	0.05	Spect	2	424B/E		06/09/89

^{*} MDL-Method Detection Limits (same units as the Results)

^{**} REF-Reference as cited on the cover (first) page of this report.

Client: The Environmental Scientific Corp.

Sample Number: 890498.3

Analysis Requested: Listed below

Date Received: 05/26/89

Date Reported: 06/12/89

of Containers: 4

Client Ident: Sediment #2

Sample Location:

Sample Description: Sediment

Sample Container: Glass jars & vials Field Prep: pH>12 for cyanide w/NaOH

pH<2 for metals W/HNO3

pH<2 for TPH w/ HCl pH<2 for TKN & phosphorous W/H2SO4

<u></u>		-		٠.				
PARAMETER	RESULT	UNITS	MDL*	INST	REF**	METHOD	EXTRACT	ANALYSIS
Total Metals					1	3050	06/07/89	
Arsenic Barium Cadmium Chromium Copper Lead Mercury Selenium Silver Vanadium Zinc	0.5 32 ND ND. 6 8 ND ND ND ND 38.9 74.7	mg/Kg mg/Kg mg/Kg mg/Kg mg/Kg mg/Kg mg/Kg mg/Kg mg/Kg	0.2 5 0.2 2 1 2 0.02 0.2 0.5 0.2	HGA AAS AAS AAS AAS CV HGA AAS ICP AAS	1 1 1 1 1 1 1	7060 7080 7130 7190 7210 7420 7471 7740 7760 6010 7950		06/08/89 06/08/89 06/08/89 06/08/89 06/08/89 06/08/89 06/08/89 06/08/89 06/08/89
% Solids	77	%		Grav	2	209A		06/08/89
EP Toxicity Extract	ion —				1	1310	06/07/89	
Arsenic Cadmium Chromium Copper Lead Mercury Nickel Vanadium Zinc	ND ND ND 0.05 ND ND 0.20 0.007 1.12	mg/L mg/L mg/L mg/L mg/L mg/L mg/L	0.00 0.02 0.03 0.03 0.04	AAS AAS 005 CV	1 1 1 1 1 1	7060 7130 7190 7210 7420 7470 7520 6010 7950		06/08/89 06/08/89 06/08/89 06/08/89 06/08/89 06/08/89 06/08/89

^{*} MDL-Method Detection Limits (same units as the Results)

^{**} REF-Reference as cited on the cover (first) page of this report.

Client: The Environmental Scientific Corp.

Sample Number: 890498.3

Analysis Requested: Listed below

Date Received: 05/26/89

Date Reported: 06/12/89

. # of Containers: 4

Client Ident: Sediment #2

Sample Location:

Sample Description: Sediment

Sample Container: Glass jars & vials Field Prep: pH>12 for cyanide w/NaOH

pH<2 for metals w/HNO3 pH<2 for TPH w/ HCl

pH<2 for TKN & phosphorous $\text{W/H}_2\text{SO}_4$

CONTINUED

PARAMETER	RESULT	UNITS	MDL*	INST	REF**	METHOD	EXTRACT	ANALYSIS
HSL Acid/Base/Neutral Extractables								
Phenol	770-	ug/Kg	1*	GC/MS	1	8270	06/01/89	06/02/89
PCB'S	ND	mg/Kg	0.25	0 GC	1	8080	06/01/89	06/02/89
Pesticides	ND	mg/Kg	0.05	GC	1	8080	06/01/89	06/02/89
HSL Volatile Organics	:							
Volatile Halocarbons	ND	ug/Kg	1*	GC/MS	3 1	8240		06/06/89
Volatile Aromatics	ND	ug/Kg	1*	GC/MS	5 1	8240		06/06/89

All compounds were below the detection limits except those listed NOTE: above.

A list of PCB'S and pesticides analyzed for accompanies this report.

^{1*} A list of acid/base neutral extractables and volatile organics analyzed for and their detection limits accompanies this report.

^{*} MDL-Method Detection Limits (same units as the Results)

^{**} REF-Reference as cited on the cover (first) page of this report.

Client: The Environmental Scientific Corp.

Sample Number: 890498.3

Analysis Requested: Listed below

Date Received: 05/26/89

Date Reported: 06/12/89

of Containers: 4

Client Ident: Sediment #2

Sample Location:

Sample Description: Sediment

Sample Container: Glass jars & vials Field Prep: pH>12 for cyanide w/NaOH

pH<2 for metals w/HNO₃ pH<2 for TPH w/ HCl

pH<2 for TKN & phosphorous w/H2SO4

CONTINUED

PARAMETER	RESULT	UNITS	MDL*	INST	REF**	METHOD	EXTRACT	ANALYSIS
Total Cyanide	ND	mg/Kg	0.4	Spect	2	412B&D		06/06/89
Total Petroleum Hydrocarbons	389	mg/Kg	40	IR	2	503B/D/	E	06/06/89
Nitrogen Nitrate as N TKN as N	ND 285	mg/Kg mg/Kg		Spect Spect		3-183 3-201D	05/26/89	05/26/89 06/09/89
Total Phosphate					5	3-227	06/09/89	
Phosphorous	3.1	0 π g/Kg	0.05	Spect	2	424B/E	 .	06/09/89

^{*} MDL—Method Detection Limits (same units as the Results)

^{**} REF—Reference as cited on the cover (first) page of this report.

Client: The Environmental Scientific Corp.

Sample Number: 890498.4

Analysis Requested: Listed below

Date Received: 05/26/89

Date Reported: 06/12/89

of Containers: 4

Client Ident: Sediment #3

Sample Location:

Sample Description: Sediment

Sample Container: Glass jars & vials

Pield Prep: pHD12 for cyanide W/NaOH pH<2 for metals w/HNO3

pH<2 for TPH w/ HCl

pH<2 for TKN & phosphorous w/H2SO4

PARAMETER	RESULT	UNITS	MDL*	INST	REF**	METHOD	EXTRACT	ANALYSIS
Total Metals					1	3050	06/07/89	
Arsenic	0.7 69	mg/Kg mg/Kg	0.2 5	HGA AAS	1	7060 7080		06/08/89 06/08/89
Barium Cadmium Chromium	0.4 6-	mg/Kg mg/Kg	0.2	AAS AAS	1 1	7130 7190		06/08/89 06/08/89
Copper Lead	14 27	mg/Kg	1 2	AAS AAS	1	7210 7420		06/08/89 06/08/89
Mercury Selenium	ND ND	mg/Kg mg/Kg	0.02 0.2	CV HGA	1 1	7471 7740		06/08/89
Silver Vanadium	ND 29.3	mg/Kg mg/Kg	0.5 0.2	AAS ICP	1	7760 6010		06/08/89 06/08/89 06/08/89
Zinc	110	mg/Kg	0.2	AAS	1	7950		
% Solids	57	%		Grav	2	209A		06/08/89
EP Toxicity Extraction	n				1	1310	06/07/89	
Arsenic Cadmium Chromium Copper Lead Mercury Nickel Vanadium Zinc	ND ND ND ND ND ND ND ND	mg/L mg/L mg/L mg/L mg/L mg/L mg/L	0.00 0.05 0.05 0.05 0.06	AAS AAS 005 CV AAS	1 1 1 1 1 1 1 1 1 1	7060 7130 7190 7210 7420 7470 7520 6010 7950		06/08/89 06/08/89 06/08/89 06/08/89 06/08/89 06/08/89 06/08/89

^{*} MDL-Method Detection Limits (same units as the Results)

^{**} REF-Reference as cited on the cover (first) page of this report.

Client: The Environmental Scientific Corp.

Sample Number: 890498.4

Analysis Requested: Listed below

Date Received: 05/26/89

Date Reported: 06/12/89

of Containers: 4

Client Ident: Sediment #3

Sample Location:

Sample Description: Sediment

Sample Container: Glass jars & vials Field Prep: pHD12 for cyanide w/NaOH

pH<2 for metals W/HNO2 pH<2 for TPH w/ HCl

pH<2 for TKN & phosphorous w/H2SO4

CONTINUED

PARAMETER	RESULT	UNITS	MDL*	INST	REF**	METHOD	EXTRACT	ANALYSIS
HSL Acid/Base/Neutra Extractables	l.	·		-				
	2,800	ug/Kg	1*	GC/MS	1	8270	06/01/89	06/02/89
PCB'S	ND	mg/Kg	0.250	o GC	1	8080	06/01/89	06/02/89
Pesticides	ND	mg/Kg	0.05	GC	1	8080	06/01/89	06/02/89
HSL Volatile Organic	s			mt		e e e	the second of the second	
Volatile Halocarbor	ns ND	ug/Kg	1*	GC/MS	1	8240		06/06/89
Volatile Aromatics	ND	ug/Kg	1*	GC/MS	5 1	8240		06/06/89

All compounds were below the detection limits except those listed NOTE: above.

1* A list of acid/base neutral extractables and volatile organics analyzed for and their detection limits accompanies this report.

A list of PCB'S and pesticides analyzed for accompanies this report.

^{*} MDL-Method Detection Limits (same units as the Results)

^{**} REF-Reference as cited on the cover (first) page of this report.

Client: The Environmental Scientific Corp.

Sample Number: 890498.4

Analysis Requested: Listed below

Date Received: 05/26/89

Date Reported: 06/12/89

of Containers: 4

Client Ident: Sediment #3

Sample Location:

Sample Description: Sediment

Sample Container: Glass jars & vials Field Prep: pH>12 for cyanide w/NaOH

pH<2 for metals W/HNO3 pH<2 for TPH w/ HCl

pH<2 for TKN & phosphorous w/H2SO4

CONTINUED

PARAMETER	RESULT	UNITS	MDL*	INST	REF**	METHOD	EXTRACT	ANALYSIS
Total Cyanide	ND	mg/Kg	0.4	Spect	2	412B&D		06/06/89
Total Petroleum Hydrocarbons	- 916	mg/Kg	40	IR	2	503B/D/	Œ	06/06/89
Nitragen Nitrate as N TKN as N	ND 595	mg/Kg mg/Kg		Spect Spect		3-183 3-201D	05/26/89	05/26/89 1.06/09/89
Total Phosphate		 5 mg/Kg		 5 Snect	5	3-227 424B/E	06/09/89 	9 06/09/89
Phosphorous	3.9	2 114/14	0.0.	, opec		7		

^{*} MDL-Method Detection Limits (same units as the Results)

^{**} REF-Reference as cited on the cover (first) page of this report.

Client: The Environmental Scientific Corp.

Sample Number: 890498.5

Analysis Requested: HSL Volatile Organics

Date Received: 05/26/89

Date Reported: 06/12/89

Client Ident: TRIP BLANK

Sample Location:

Sample Description: Water Sample Container: Glass vials

Field Prep: None

of Containers: 4

PARAMETER	RESULT	UNITS	MDL*	INST	REF**	METHOD	EXTRACT	ANALYSIS
			,					
HSL Volatile Organics								
Volatile Halocarbons	ND	ug/L	1*	GC/MS	1	8240		06/06/89
Volatile Aromatics	ND	ug/L	1*	GC/MS	: 1	8240		06/06/89

NOTE: All compounds were below the detection limits except those listed above.

- 1* A list of volatile organics analyzed for and their detection limits accompanies this report.
 - A list of PCB'S and pesticides analyzed for accompanies this report.

^{*} MDL-Method Detection Limits (same units as the Results)

^{**} REF—Reference as cited on the cover (first) page of this report.

Client: The Environmental Scientific Corp.

Sample Number: 890498.1-.4

Analysis Requested: HSL Acid/Base/Neutral

Date Received: 05/26/89

Extractables (Surrogate Recovery)

Date Reported: 06/12/89

Client Ident:

Sample Location:

Sample Description: Water & soil Sample Container: Glass bottle & jars

Field Prep: None

of Containers: 4

PARAMETER	890498.1	890498.2	890498.3	890498.4	
2-Fluorophenol Phenol-d5 Nitrobenzene-d5 2-Fluorobiphenyl 2,4,6-Tribromophenol 4-Terphenyl-d14	7% 9% 40% 61% 41% 87%	. 36% 44% 62% 95% 93% 86%	15% 19% 23% 43% 25% 52%	35% 46% 60% 93% 72% 68%	

^{*} MDL-Method Detection Limits (same units as the Results)

^{**} REF-Reference as cited on the cover (first) page of this report.

HSL ACID EXTRACTABLES

METHOD DETECTION LIMIT PARAMETER 3.3 ug/L 2-Chlorophenol 3.6 ug/L 2-Nitrophenol 1.5 ug/L Phenol 2.7 ug/L 2,4-Dimethylphenol 2.7 ug/L 2,4-Dichlorophenol 2.7 ug/L 2,4,6-Trichlorophenol 3.0 ug/L 4-Chloro-3-methylphenol (p-chloro-m-cresol) 42.0 ug/L 2,4-Dinitrophenol 24.0 ug/L 2-Methyl-4,6-dinitrophenol 3.6 ug/L Pentachlorophenol 2.4 ug/L 4-Nitrophenol 10.0 ug/L Benzyl alcohol 10.0 ug/L 2-Methyl phenol 10.0 ug/L 4-Methyl phenol 10.0 ug/L Benzoic acid 10.0 ug/L 2,4,5-Trichlorophenol

Detection limits for 890498.1 are listed above.

Detection limits for 890498.2 & .4 are 100X greater than above.

Detection limits for 890498.3 are 50X greater than above.

Acenaphthene		1.9 ug/L
Benzidine		44.0 ug/L
1,2,4-Trichlorobenzene		1.9 ug/L
Hexachlorobenzene		1.9 ug/L
Bis(2-chloroethyl)ether		5.7 ug/L
2-Chloronaphthalene		1.9 ug/L
1,2-Dichlorobenzene		1.9 ug/L
1,3-Dichlorobenzene	_	1.9 ug/L
1,4-Dichlorobenzene		4.4 ug/L
3,3-Dichlorobenzidine		16.5 ug/L
2,4-Dinitrotoluene		5.7 ug/L
2,6-Dinitrotoluene		1.9 ug/L
1,2-Diphenylhydrazine		11.1 ug/L
Flouranthene		2.2 ug/L
4-Chlorophenyl phenyl ether		4.2 ug/L
4-Bromophenyl phenyl ether	•	1.9 ug/L
Bis(2-chloroisopropyl)ether	•	5.7 ug/L
Bis(2-chloroethoxy)methane		5.3 ug/L
Hexachlorobutadiene		0.9 ug/L
Hexachlorocyclopentadiene		5.1 ug/L
Isophorone	•	2.2 ug/L
Naphthalene	•	1.6 ug/L
Nitrobenzene		1.9 ug/L
N-nitrosodimethlyamine		3.1 ug/L
N-nitrosodiphenylamine -		1.9 ug/L
N-nitrosodi-n-propylamine		$2.6~\mathrm{ug/L}$
Bis(2-ethylhexyl)phthalate		$2.5~{ m ug/L}$
Butyl benzyl phthalate		$2.5~{ m ug/L}$
Di-n-butylphthalate		$2.5~\mathrm{ug/L}$
Di-n-octylphthalate		$2.5~{ m ug/L}$
Diethyl phthalate		22.0 ug/L
Dimethyl phthalate		$1.6~{ m ug/L}$
Benzo(a) anthracene		7.8 ug/L
		2.5 ug/L
Benzo(a) pyrene		4.8 ug/L
Benzo(b) flouranthene Benzo(k) flouranthene		2.5 ug/L
		2.5 ug/L
Chrysene		$3.5~\mathrm{ug/L}$
Acenaphthylene		1.9 ug/L
Anthracene		4.1 ug/L
Benzo(ghi)perylene		1.9 vg/L
Flourene		5.4 ug/L
Phenanthrene		2.5 ug/L
Dibenzo(a,h)anthracene		3.7 ug/L
Indeno(1,2,3-cd)pyrene		1.9 ug/L
Pyrene		1.6 ug/L
Hexachloroethane		5.0 ug/L
Aniline 4—Chloroaniline		5.0 ug/L
		10.0 ug/L
2-Methyl naphthalene		10.0 ug/L
2-Nitro aniline		5.0 ug/L
Dibenzofuran		

Detection limits for 890498.1 are listed above.

Detection limits for 890498.2 & .4 are 100X greater than above.

Detection limits for 890498.3 are 50X greater than above.

HSL VOLATILE ORGANICS by GC/MS Method 624

PARAMETER METHOD DETECTION LIMIT

Methylene chloride	2.8 ug/L
1,1-Dichloroethane	4.7 ug/L
Chloroform	1.6 ug/L
Carbon tetrachloride	2.8 ug/L
1,2-Dichloropropane,	·6.0 ug/L
Dibromochloromethane	3.1 ug/L
1,1,2-Trichloroethane	5.0 ug/L
2-Chloroethylvinyl ether	10.0 ug/L
Tetrachloroethene	4.1 ug/L
Chlorobenzene	6.0 ug/L
Trichlorofluoromethane .	5.0 ug/L
1,2-Dichloroethane	2.8 ug/L
1,1,1-Trichloroethane	3.8 ug/L
Bromodichloromethane	2.2 ug/L
trans-1,3-Dichloropropene	5.0 ug/L
Cis-1,3-Dichloropropene	5.0 ug/L
Bromoform	4.7 ug/L
1,1,2,2-Tetrachloroethane	6.9 ug/L
Benzene	6.0 ug/L
Toluene	6.0 ug/L
Ethyl benzene	7.2 ug/L
Xylenes	10.0 ug/L
Chloromethane	8.0 ug/L
Bromomethane	7.0 ug/L
Vinyl chloride	6.5 ug/L
Chloroethane	7.5 ug/L
1,1-Dichloroethene	2.8 ug/L
1,2-Dichloroethene	1.6 ug/L
Trichloroethene	1.9 ug/L
1,2-Dichlorobenzene	10.0 ug/L
1,3-Dichlorobenzene	10.0 ug/L
1,4-Dichlorobenzene	10.0 ug/L
Acetone	500.0 ug/L
Carbon disulfide	20.0 ug/L-
2-Butanone	30.0 ug/L
Vinyl acetate	30.0 ug/L
4-Methyl-2-pentanone	20.0 ug/L
2-Hexanone	20.0 ug/L
	10.0 ug/L
Styrene o-Xylene	10.0 ug/L
O-VATEUR.	

Detection limits for 890498.1 & .5 are listed above. Detection limits for 890498.2, .3 & .4 are 10X greater than above.

PESTICIDE

PARAMETER

Alpha BHC Lindane (gamma BHC) Beta BHC Delta BHC Heptachlor Alachlor Aldrin Atrazine Heptachlor epoxide Endrin Endrin aldehyde Endrin ketone Dieldrin p,p'-DDE p,p'-DDD p,p'-DDT Endosulfan I Endosulfan II Endosulfan sulfate Methoxychlor Chlordane Toxaphene

POLYCHLORINATED BIPHENYLS

PARAMETER

PCB 1016 Arochlor 1221 Arochlor 1232 Arochlor 1242 Arochlor 1254 Arochlor 1254 Arochlor 1260 Arochlor 1262 Arochlor 1268)

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